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Applicant W.L. GORE & ASSOCIATES GMBH et al	

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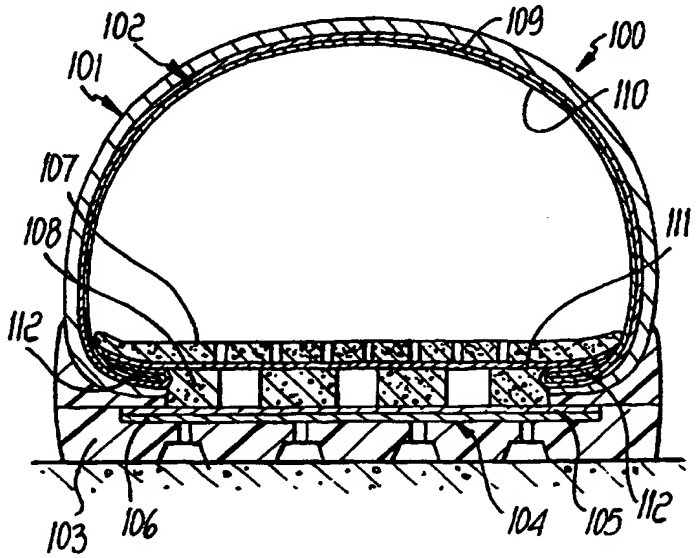

(57) Abstract

A vapor-permeable shoe, including the following combination of elements: a vapor-permeable upper (101) associated with a vapor-permeable or perforated lining (102); a tread (103) made of perforated elastomer; a mid-sole (104) comprising at least one membrane (105) made of waterproof vapor-permeable material that is associated with a lower protective layer (106) made of hydrolysis-resistant, water-repellent, vapor-permeable or perforated material; a vapor-permeable or perforated insole (107); a vapor-permeable or perforated filler layer (108) arranged between the insole (107) and the membrane (105). The lower part of the upper (101), the tread (103), the mid-sole (104) with the membrane (105) are perimetrically sealed in the coupling regions.

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VAPOR-PERMEABLE SHOE

Technical field

The present invention relates to a vapor-permeable shoe.

Background Art

It is known that a shoe, in order to be comfortable, must ensure the correct exchange of heat and water vapor between the internal microclimate of the shoe and the external climate.

This exchange of heat and water vapor, however, must not compromise in any way the tightness of the shoe with respect to external moisture or water.

Currently commercially available shoes entrust this heat and water vapor exchange substantially to the upper or to the sole.

As regards the upper, shoes provided with perforations and/or with linings made of vapor-permeable and waterproof material are currently commercially available.

In some models, parts of the upper may be replaced with materials that are indeed waterproof and at the same time vapor-permeable.

Another category of shoes instead entrusts vapor-permeability to the sole, again by using layers of waterproof and vapor-permeable material, optionally associated with protective layers and fillers.

Disclosure of the Invention

A principal aim of the present invention is to provide a vapor-permeable shoe that allows the exchange of heat and water vapor both through the upper and through the sole, ensuring at all times an optimum internal microclimate as a

function of the external climate.

Accordingly, an object of the present invention is to provide a vapor-permeable shoe the structure whereof is in no way restrictive in terms of styling and aesthetic research, allowing the greatest freedom in shoe shapes and types.

Another object of the present invention is to provide a vapor-permeable shoe that is meant both for everyday use and for sports use.

Another object of the present invention is to provide a vapor-permeable shoe the cost whereof is competitive with respect to the costs of conventional vapor-permeable shoes.

Another object of the present invention is to provide a vapor-permeable shoe that can be manufactured with conventional technologies.

This aim, these objects, and others that will become apparent hereinafter are achieved by a vapor-permeable shoe, according to the present invention, characterized in that it comprises the following combination of elements:

-- a vapor-permeable upper associated with a vapor-permeable or perforated lining;

-- a tread made of perforated elastomer;

-- a mid-sole comprising at least one membrane made of waterproof vapor-permeable material that is associated with a lower protective layer made of hydrolysis-resistant, water-repellent, vapor-permeable or perforated material;

-- a vapor-permeable or perforated insole;

-- a vapor-permeable or perforated filler layer arranged between said insole and said membrane;

the lower part of said upper, said tread, said mid-sole

with said membrane being perimetrically sealed in the coupling regions.

Brief Description of the Drawings

Further characteristics and advantages of the present invention will become apparent from the following detailed description of eight embodiments thereof, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

figure 1 is a longitudinal sectional view of a shoe according to the invention, in a first embodiment;

figure 2 is an axonometric cutout view of a detail of the shoe of figure 1;

figure 3 is a transverse sectional view of a shoe according to the invention, in a second embodiment;

figure 4 is a transverse sectional view of a shoe according to the invention, in a third embodiment;

figure 5 is a longitudinal sectional view of a shoe according to the invention, in a fourth embodiment;

figure 6 is an axonometric cutout view of a detail of the shoe of figure 5;

figure 7 is a transverse sectional view of the shoe of figure 5;

figure 8 is a transverse sectional view of a shoe according to the invention in a fifth embodiment;

figure 9 is a transverse sectional view of a shoe according to the invention, in a sixth embodiment;

figure 10 is a front view of a detail of a shoe according to the invention, in a seventh embodiment;

figure 11 is a transverse sectional view of a shoe according to the invention, in a seventh embodiment;

figure 12 is a transverse sectional view of a shoe according to the invention, in an eighth embodiment.

Ways of carrying out the Invention

With particular reference to figures 1 and 2, a vapor-permeable shoe, according to the invention, is generally designated by the reference numeral 10 in a first embodiment.

The shoe 10 comprises, in this case, an upper 11 that is vapor-permeable (made for example of natural leather without sealing pigments) and is associated with a vapor-permeable or perforated lining 12 (for example made of so-called "cambrelle").

The lining 12 is associated with the upper 11 by spot gluing, so as to avoid compromising transpiration through said upper.

The shoe 10 furthermore comprises a tread 13 made of perforated elastomer and a mid-sole, generally designated by the reference numeral 14, that comprises a membrane 15 made of waterproof and vapor-permeable material, such as those commercially available and commonly defined by the trade name GORE-TEX, associated with a protective layer 16 that is directed towards the tread 13 and is made of a hydrolysis-resistant, water-repellent, vapor-permeable or perforated material.

The shoe 10 also comprises: an insole 17 made of vapor-permeable material (for example natural leather) or perforated material, with an optional heel seat made of soft leather with absorbent latex rubber, and a perforated filler layer 18 made of injected thermoplastic material that is arranged on the tread 13 with the membrane 15.

A vapor-permeable or perforated toe cup 19 is furthermore applied to the shoe 10, in this first embodiment, and is associated with the upper 11 by spot gluing so as to ensure its transpiration.

Likewise, a rear vapor-permeable or perforated counter 20 is associated with the upper 11 by spot gluing.

The upper 11, in this case, is associated with the insole 17 by applying a layer of glue along a perimetric band.

Limiting the gluing layer to a perimetric band allows to leave transpiration unaffected over much of the surface of the foot sole.

The shoe 10 in fact has a central part of the insole that is entirely free of any element that is impermeable to water vapor (non-vapor-permeable).

Furthermore, the membrane 15 and the lower protective layer 16 are coupled one another by spot gluing, by using a commercially available adhesive that is resistant to hydrolysis (a type commonly known as "hot merc" or systems with calendered powders).

As regards the protective layer 16, it can be conveniently made of water-repellent material capable of quickly drying, such as for example non-woven fabric or needle-loomed felt, or KEVLAR.

Said protective layer 16 is furthermore directed downwards, i.e., towards the tread 13, since it must protect the membrane 15 against external impacts or against foreign objects that may penetrate through the holes formed in said tread 13.

The association between the protective layer 16 and the

tread 13 occurs by means of a commercially available and hydrolysis-resistant adhesive by spot gluing or by gluing along a perimetric band, so as to ensure vapor-permeability of the sole as a whole.

Furthermore, the coupling of the membrane 15 to the insole 17 and to the tread 13 must be provided so as to ensure a seal against external water along its entire perimeter, and this can occur by perimetric gluing, by using hydrolysis-resistant adhesives or high-frequency welding or through overlap injection-molding, on the tread 13, of compatible material that allows perfect adhesion of the membrane 15 to the tread 13 directly or by means of the protective layer 16.

The shoe according to the invention, as shown by the description of this first embodiment thereof, is vapor-permeable as a whole, any non-vapor-permeable regions having been limited substantially to the perimetric regions of the sole, which must besides ensure a good seal against water and external moisture.

Vapor-permeability can be increased further, through the sole as a whole, if the insole 17 is applied to the upper 11 with stitches, so that the entire surface of said insole 17 is vapor-permeable because it is not affected by glue.

With particular reference to figure 3, a shoe according to the invention is generally designated by the reference numeral 100 in a second embodiment.

The shoe 100 comprises an upper 101 that is associated with an internal lining 102 that is generally vapor-permeable or perforated.

The shoe 100, like the shoe 10, comprises a perforated elastomeric tread 103 and a mid-sole, generally designated by the reference numeral 104, that comprises a membrane 105 of waterproof and vapor-permeable material associated with a lower protective layer 106 made of hydrolysis-resistant, water-repellent, vapor-permeable or perforated material.

The shoe 100 furthermore comprises a vapor-permeable or perforated insole 107 and a vapor-permeable or perforated filler layer 108 that is arranged between said insole 107 and the membrane 105.

The shoe 100 differs from the shoe 10 in that the lining 102 is composite, since it is formed by an outer layer, constituted by a waterproof and vapor-permeable membrane 109 the characteristics whereof are similar to those of the membrane 105, and by an inner layer, which is directed towards the foot, is designated by the reference numeral 110, and is made of leather or vapor-permeable fabric.

In this second embodiment, the perimetric region of the shoe 100 is furthermore sealed by folding the advantageously protruding edge of the membrane 109, which is welded, again along a perimetric band, to the edge of a waterproof and vapor-permeable membrane 111 the characteristics whereof are similar to those of the membrane 105; said membrane 111 is arranged below the insole 107 with which it is associated.

More specifically, the membrane 109 is cut so that it is larger than the upper 101 and its border protrudes from said upper.

During the application of the insole 107, of the mid-sole 104, and of the tread 103, the excess border of the

membrane 109 is folded upwards and outwards, so as to provide a perimetric surface whereon the corresponding perimetric border of the membrane 111 is glued.

In this manner, the membrane 109 forms a perimetric pocket 112 that seals the sole as a whole against water and external moisture.

Furthermore, if part of the insole 107 is glued to the tread 103, water is also sealed out of the lightening hollows.

With particular reference to figure 4, a shoe according to the invention is generally designated by the reference numeral 200 in a third embodiment.

The shoe 200 comprises an upper 201 that is associated with a lining 202.

The shoe 200 furthermore comprises a tread 203 made of perforated elastomer and a mid-sole, generally designated by the reference numeral 204, which comprises a membrane 205 made of waterproof and vapor-permeable material that is associated with a lower protective layer 206 made of a hydrolysis-resistant, water-repellent, vapor-permeable or perforated material.

The shoe 200 furthermore comprises a vapor-permeable or perforated insole 207 and a vapor-permeable or perforated filler layer 208 that is arranged between the insole 207 and the membrane 205.

As in the second embodiment, the shoe 200 has a lining 202 that is composite, since it is constituted by an outer layer, constituted by a membrane 209 made of vapor-permeable waterproof material with characteristics that are similar to those of the membrane 205, and by an inner layer 210, made

of leather or vapor-permeable fabric.

This third embodiment differs from the second one in the method used to seal the lower perimetric regions.

In this third embodiment, the perimetric region is in fact waterproofed by welding the membrane 209 directly on the tread 203 or on a sealing element 211 that is also formed monolithically with respect to the tread 203.

With particular reference now to figures 5, 6, and 7, a vapor-permeable shoe according to the invention is generally designated by the reference numeral 310 in a fourth embodiment.

The shoe 310 comprises, in this case, a vapor-permeable upper 311 (made for example of natural leather without sealing pigments) associated with a vapor-permeable or perforated lining 312 (for example made of so-called "cambrelle").

The lining 312 is associated with the upper 311 by spot gluing, so as to avoid compromising transpiration through said upper.

The shoe 310 furthermore comprises a tread 313, which is made of elastomer, is perforated at the bottom, and has a raised border 313a, and a mid-sole, generally designated by the reference numeral 314, that comprises a membrane 315 made of waterproof and vapor-permeable material, such as those commercially available and commonly defined by the trade-name GORE-TEX, associated with a protective layer 316, which is directed towards the tread 313, is made of hydrolysis-resistant, water-repellent, vapor-permeable or perforated material, and is thinner in the perimetric regions to move the membrane 315 gradually closer to the

tread 313.

The mid-sole 314 is surrounded by the border 313a of the tread 313.

The shoe 310 furthermore comprises: an insole 317 made of vapor-permeable material (for example natural leather) or perforated material, with an optional heel seat made of soft leather with absorbing latex rubber, and a filler layer 318 made of vapor-permeable felt arranged on the tread 313 with the membrane 315.

A vapor-permeable or perforated tip 319 is furthermore applied to the shoe 310, in this fourth embodiment, and is associated with the upper 311 by spot gluing so as to ensure its transpiration.

Likewise, a vapor-permeable or perforated rear counter 320 is associated with the upper 311 by spot gluing.

The upper 311, in this case, is associated with the insole 317 by applying a layer of glue along a perimetric band.

Limiting the gluing layer to a perimetric band allows to keep transpiration intact for much of the surface of the foot sole.

In the shoe 310, the central part of the insole is in fact entirely free of any element that is impermeable to water vapor (non-vapor-permeable).

The membrane 315 and the protective layer 316 are coupled one another by spot gluing, by using a commercially available hydrolysis-resistant glue (of the type commonly known as "hot merc" or systems with calendered powders).

As regards the protective layer 316, it can be conveniently made of water-repellent material capable of

drying quickly, such as for example non-woven fabric or needle-loomed felt.

Furthermore, said protective layer 316 is directed downwards, i.e., towards the tread 313, since it must protect the membrane 315 against external impacts or against foreign objects that might penetrate through the holes formed in said tread 313.

According to the invention, the membrane 315 is joined to the tread 313 by means of a commercially available hydrolysis-resistant adhesive along a perimetric band 315a, where the protective layer 316 is thinner and therefore the adhesive can penetrate so as to pass through it, forming a sandwich-like unit.

The membrane 315 must furthermore be fixed to the tread 313 so as to ensure tightness against external water along its entire perimeter, and this can occur by gluing, using hydrolysis-resistant glues or with high-frequency welds or also by overlap injection-molding, on the tread 313, of compatible material that allows perfect adhesion.

The shoe according to the invention, as shown by the description of this fourth embodiment, is generally vapor-permeable, any non-vapor-permeable regions having been limited substantially to the perimetric regions of the sole, which must in any case ensure tightness against water and external moisture.

Transpiration can be increased further, through the sole as a whole, if the insole 317 is applied to the upper 311 with stitches, thus allowing the entire surface of the insole 317 to be vapor-permeable since it is not affected by glue.

With particular reference to figure 8, a shoe according to the invention is generally designated by the reference numeral 400 in a fifth embodiment.

The shoe 400 comprises an upper 401 that is associated with an internal lining 402 that is generally vapor-permeable or perforated.

The shoe 400, like the shoe 310, comprises a tread 403, made of perforated elastomer with a raised border 403a, and a mid-sole that is generally designated by the reference numeral 404 and comprises a membrane 405, made of waterproof and vapor-permeable material, that is associated with a lower protective layer 406 made of hydrolysis-resistant, water-repellent, vapor-permeable or perforated material, the border 406a whereof is internal and spaced from the border 405a of the membrane 405, which preferably surrounds the perforated regions of the tread 403.

The shoe 400 furthermore comprises a vapor-permeable or perforated insole 407 and a vapor-permeable or perforated filler layer 408 that is arranged between said insole 407 and the membrane 405.

The shoe 400 differs, with respect to the shoe 310, in that the membrane 405 is perimetrically glued directly to the tread 403, this part being free from the protective layer 406.

With particular reference to figure 9, a shoe according to the invention is generally designated by the reference numeral 500 in a sixth embodiment.

The shoe 500 can be produced with the following method: an insole 517, made of vapor-permeable material (for example natural leather) or perforated, is applied to an upper 511

that is also vapor-permeable (for example made of natural leather without sealing pigments) and is associated with a vapor-permeable or perforated lining 512.

Then, after inserting the upper 511 in the last 502 of a mold 520, a vapor-permeable filler layer 518 is first applied in a downward region, followed by a membrane 515 made of waterproof and vapor-permeable material, of the type commercially available under the trade-name GORE-TEX.

The membrane 515 and the protective layer 518 arranged above it are mutually assembled by perimetric gluing or by spot gluing, so as to avoid compromising the vapor-permeability of the shoe 500.

A protective layer 516 of hydrolysis-resistant, water-repellent, vapor-permeable or perforated material is associated below the membrane 515 and is smaller than the membrane 515 or perimetrically thinner.

The vapor-permeable element composed of the filler layer 518, the membrane 515, and the protective layer 516 is applied perimetrically or by spots below the insole 517 or is coupled or deposited above the hollow part of the mold 520 at the perforated part of the sole, above metallic pins 521 that will form holes 522.

The mold 520 is then closed over the upper 511, so that the contact between the insole 517, the vapor-permeable element formed by the filler layer 518, the membrane 515, and the protective layer 516 and said mold 520 prevents infiltration of the material above the metallic pins 521, obstructing the holes 522.

The material of the tread 503 is injected; by adhering to the membrane 515 around its perimeter, said material

seals said tread 503 against water infiltration.

Said seal can be further ensured by adhesives adapted for the automatic sealing of the two surfaces.

The described method can also be used to form the sole on its own, without direct application to the upper.

With particular reference to figures 10 and 11, a vapor-permeable shoe according to the invention is generally designated by the reference numeral 600 in a seventh embodiment.

Said shoe 600 comprises a vapor-permeable upper 611 (made of natural leather without sealing pigments), which is associated with a vapor-permeable or perforated lining 612 by spot gluing, and an insole 617, which is also made of vapor-permeable material (for example natural leather) or is perforated.

The shoe 600, in this case, is obtained by following a method that entails the insertion of an insert 610 made of synthetic material in a mold 620.

Said insert 610 is preformed by means of a substantially lower first perforated tread element 613, above which a protective layer 616, a membrane 615, and then a perforated filler layer 618, which acts as upper seal, are associated.

Said components have the same vapor-permeable characteristics described in the above embodiments, since they in fact ensure the flow of transpiration from the inside of the shoe outwards.

Thus, the membrane 615 is made of waterproof and vapor-permeable material, such as GORE-TEX, and the protective layer 616 is made of hydrolysis-resistant, water-repellent,

vapor-permeable or perforated material.

Once said insert 610, which is present throughout the thickness of the sole, has been inserted in the mold 620, said mold is closed and the second substantially perimetric tread element 603 is molded or injection-molded, so as to constitute an element that is monolithic with the insert 610 and with the upper 611.

With particular reference to figure 12, a vapor-permeable shoe according to the invention is generally designated by the reference numeral 700 in an eighth embodiment.

The shoe 700 comprises an upper 711 that is associated with an internal lining 712, that is vapor-permeable or perforated as a whole and is provided with an insole 717 that is also made of vapor-permeable or perforated material and is assembled by spot gluing or along a perimetric band.

The shoe 700 is obtained by using a mold of the "two-color" type 720, according to a method for the injection-molding of a first substantially lower tread element 702 provided with holes 703.

Said first tread element 702 can conveniently also be molded separately and then inserted in the mold 720.

A protective layer 716 of the type used in the previous embodiments is arranged in an upward position at the region affected by the holes 703 and is directed downwards; a membrane 715, made of waterproof and vapor-permeable material, is placed above said layer.

A filler layer 718 is arranged above said membrane 715 and is vapor-permeable, as in this case, or perforated; said layer is smaller than the membrane 715, so as to leave a

perimetric surface 719 of said membrane exposed.

Said surface 719 can be coated with glue to improve the seal of the shoe 700 against any water infiltrations.

The mold 720 is then closed so that the insole 717 sufficiently compresses the vapor-permeable mid-sole, which is composed of the combination of the filler layer 718, of the membrane 715, and of the protective layer 716, so as to avoid relative movements among the various components of the shoe.

By injecting the second tread 704, the seal is formed on the perimetric surface 719 and the structure becomes monolithic.

There is also a final embodiment of a vapor-permeable shoe that uses a "single-color" mold for the injection-molding of an entire tread monolithically.

This last vapor-permeable shoe configuration comprises an upper having an internal lining and an insole that are conveniently vapor-permeable or perforated.

A filler layer, a membrane, and a protective layer are placed on the lower face of the insole; said protective layer is directed downwards.

Said filler layer is also smaller than the membrane, so as to leave a perimetric surface of said membrane exposed.

The shoe is completed by injecting the material of the tread, on the lower face whereof holes are formed by means of metal pins.

In practice it has been observed that the present invention has achieved the intended aim and objects; in particular, it should be noted that the shoe according to the invention perfectly complies with the requirement of

having an optimum exchange of heat and water vapor between the internal microclimate and the external climate, while nonetheless maintaining full waterproofing and moisture-proofing.

It should be noted that all this has been achieved while maintaining a shoe structure that is highly flexible and adaptable to any styling type and to any aesthetic and economical level required by the market.

It should also be noted that the shoe according to the invention can be mass-produced easily, since the operations can be fully automated.

Another remark should be made as to the fact that the shoe according to the invention allows a certain flexibility in terms of the association of its components, leading to considerable production savings in relation to flexibility and adaptability to various production conditions and situations.

The present invention is susceptible of numerous modifications and variations, all of which are within the scope of the inventive concept; all the details may furthermore be replaced with other technically equivalent elements.

The material and the dimensions may be any according to the requirements.

CLAIMS

1. Vapor-permeable shoe, characterized in that it comprises the following combination of elements:

-- a vapor-permeable upper (11,101,201,311,401,511,611, 711) that is associated with a vapor-permeable or perforated lining (12,102,202,312,402,512,612,712);

-- a tread (13,103,203,313,403,503,603,702) made of perforated elastomer;

-- a mid-sole (14,104,204,314,404) comprising at least one membrane (15,105,205,315,405,515,615,715) made of waterproof vapor-permeable material that is associated with a lower protective layer (16,106,206,316,406,516,616,716) made of hydrolysis-resistant, water-repellent, vapor-permeable or perforated material;

-- a vapor-permeable or perforated insole (17,107,207,317,407,517,617,717);

-- a vapor-permeable or perforated filler layer (18,108,208,318,408,518,618,718) arranged between said insole and said membrane;

the lower part of said upper, said tread, said mid-sole with said membrane being perimetrically sealed in the coupling regions.

2. Vapor-permeable shoe according to claim 1, characterized in that said lining (102) is composite, since it comprises an externally directed layer, constituted by a waterproof and vapor-permeable membrane (109), and an internally directed layer (110), made of leather or vapor-permeable fabric, said lining (102) being larger than said upper (101), the protruding border of said lining being

folded upwards and outwards and being glued to the perimetric border of a waterproof and vapor-permeable membrane (111) arranged below said insole (107) and associated therewith, the association of both membranes forming a perimetric pocket (112) for sealing against moisture and water.

3. Vapor-permeable shoe according to claim 1, characterized in that said lining (202) is composite and is welded directly to the tread (203) or to a sealing element (211) that is formed monolithically with said tread (203).

4. Vapor-permeable shoe according to one or more of the preceding claims, characterized in that it comprises a vapor-permeable or perforated tip (319) that is associated with said upper (311) by spot gluing.

5. Vapor-permeable shoe according to one or more of the preceding claims, characterized in that it comprises a vapor-permeable or perforated rear counter (320) that is associated with said upper (311) by spot gluing.

6. Vapor-permeable shoe according to one or more of the preceding claims, characterized in that said lining (312) and said upper (311) are associated one another by spot gluing.

7. Vapor-permeable shoe according to one or more of the preceding claims, characterized in that said upper (311) and said insole (317) are associated and sealed one another by means of adhesive arranged along a perimetric region, so as to allow full transpiration in the central region.

8. Vapor-permeable shoe according to one or more of the preceding claims, characterized in that said membrane (315) and said protective layer (316) are associated by spot

gluing with hydrolysis-resistant adhesive or with calendered powders.

9. Vapor-permeable shoe according to one or more of the preceding claims, characterized in that said protective layer (316) is made of non-woven fabric or needle-loomed felt.

10. Vapor-permeable shoe according to one or more of the preceding claims, characterized in that the association between said protective layer (316) and said tread (313) is provided by spot gluing with a hydrolysis-resistant adhesive.

11. Vapor-permeable shoe according to one or more of the preceding claims, characterized in that said tread (313) and said membrane (315) are sealed and associated one another by gluing with hydrolysis-resistant adhesives or by high-frequency welding or by overlap injection-molding of a material that is compatible with the material of said tread, so as to form a perimetric seal.

12. Vapor-permeable shoe according to one or more of the preceding claims, characterized in that said upper (311) and said insole (317) are associated by means of stitches.

13. Vapor-permeable shoe, characterized in that it comprises the following combination of elements:

-- a vapor-permeable upper (311) associated with a vapor-permeable or perforated lining (312);

-- a tread (313) made of perforated elastomer;

-- a mid-sole (314) comprising at least one membrane (315) made of waterproof and vapor-permeable material, associated with a lower protective layer (316) made of hydrolysis-resistant, water-repellent, vapor-permeable, or

perforated material;

-- a vapor-permeable or perforated insole (317);

-- a vapor-permeable or perforated filler layer (408) arranged between said insole (317) and said membrane (315);

said tread (313) and said membrane (315) being sealed in the perimetric coupling regions, where said lower protective layer (316) is thinner or not present.

14. Vapor-permeable shoe according to claim 13, characterized in that said tread (313) has a raised border (313a) that contains said mid-sole (314).

15. Vapor-permeable shoe according to claim 13, characterized in that said filler layer (318) is made of vapor-permeable felt.

16. Vapor-permeable shoe according to one or more of claims 13 to 15, characterized in that said upper (311) and said insole (317) are associated one another by gluing or by means of stitches along a perimetric band.

17. Vapor-permeable shoe according to one or more of claims 13 to 16, characterized in that said membrane (315) and said protective layer (316) are associated by spot gluing with hydrolysis-resistant adhesive or by calendered powders.

18. Vapor-permeable shoe according to one or more of claims 13 to 17, characterized in that said protective layer (316) is made of non-woven fabric or needle-loomed felt.

19. Vapor-permeable shoe according to one or more of claims 13 to 18, characterized in that the association and seal between said tread (313) and said membrane (315) is provided by gluing with hydrolysis-resistant adhesives or by high-frequency welding or by overlap injection-molding of a

material that is compatible with the material of said tread, so as to form a perimetric seal.

20. Method for manufacturing a shoe according to claim 13, consisting in:

-- fitting said upper, with an insole and a lining, on the last of a mold for injection-molding;

-- applying, in a downward region, said filler layer with a membrane and a protective layer;

-- closing the mold and injecting said tread so as to seal the entire assembly with respect to the upper.

21. Shoe according to claim 13, characterized in that said tread comprises two monolithic elements that are formed by successive injection-molding operations, a first element being arranged substantially below said membrane and a second element being perimetric.

22. Method for producing a shoe according to claim 21, consisting in:

-- molding an insert with a first perforated tread element, a membrane, a protective layer, and a filler layer made of perforated elastomer;

-- inserting said insert in a mold and fitting the upper, with the insole and the lining, on the last;

-- molding the second tread element and sealing the entire assembly.

23. Vapor-permeable shoe according to claim 1, characterized in that it comprises the following combination of elements:

-- a vapor-permeable upper (711) associated with a vapor-permeable or perforated lining (712);

-- a tread (702) made of perforated elastomer;

-- a mid-sole comprising at least one membrane (715) made of waterproof and vapor-permeable material that is hydrolysis-resistant, water-repellent, vapor-permeable, or perforated;

-- a vapor-permeable or perforated insole (717);

-- a vapor-permeable or perforated filler layer (718) arranged between said insole (717) and said membrane (715) and having perimetric dimensions that are smaller than those of said membrane (715);

-- said tread (702) and said membrane (715) being sealed in the perimetric coupling regions.

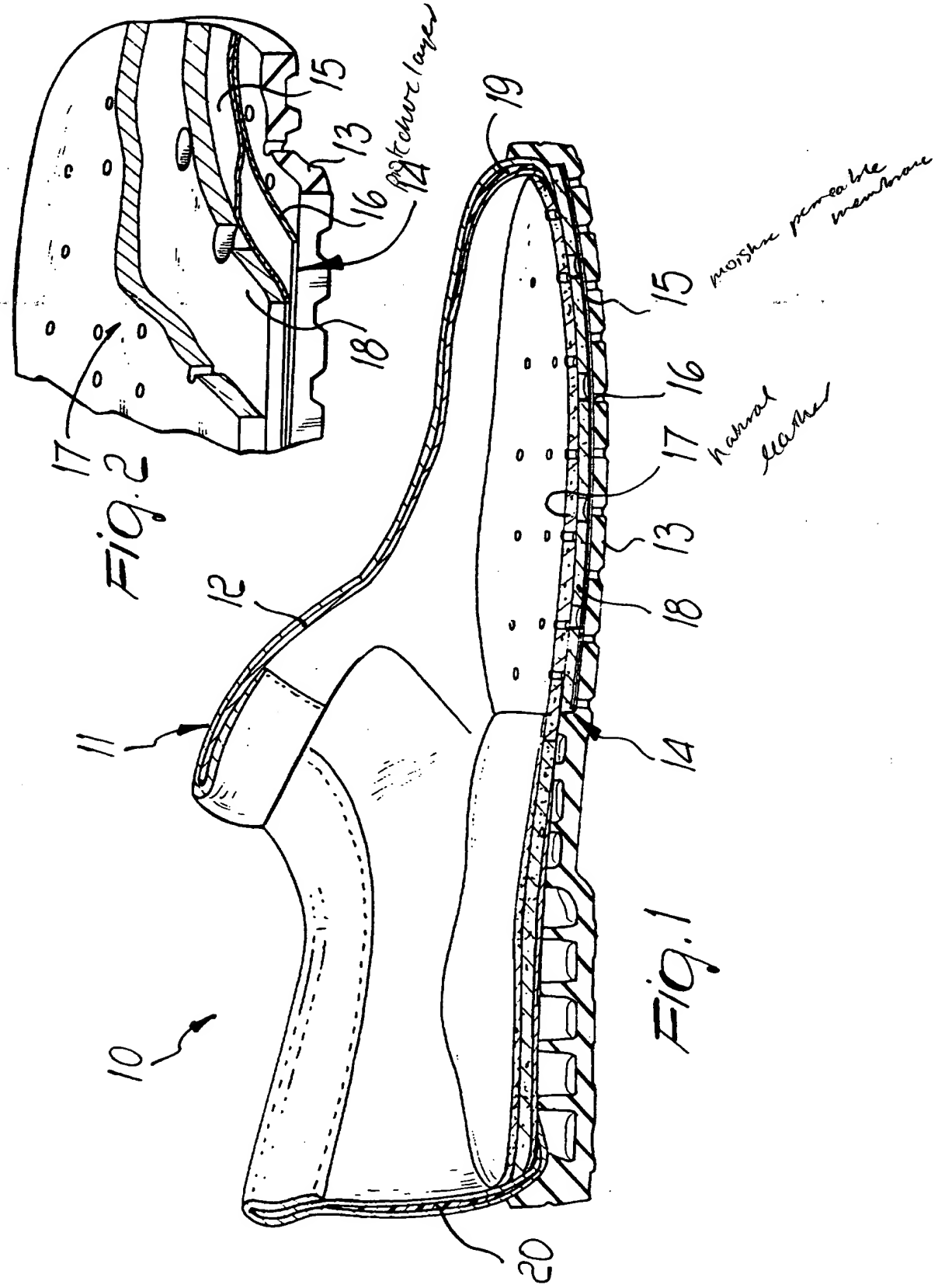
24. Method for producing a shoe according to claim 23, consisting in:

-- fitting said upper, together with an insole and a lining, on the last of a mold for injection-molding;

-- applying, in a downward region, said filler layer, which has smaller dimensions, together with a membrane, a protective layer, and optional pre-molded parts of a perforated tread;

-- closing the mold and injection-molding said tread or the remaining tread parts so as to seal the entire assembly to the upper.

25. Method for producing a shoe according to claim 20 or 24, characterized in that auxiliary adhesives, adapted to seal the surfaces one another, can contribute to the sealing action.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12
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moisture permeable membrane
natural leather

Fig. 2

Fig. 1

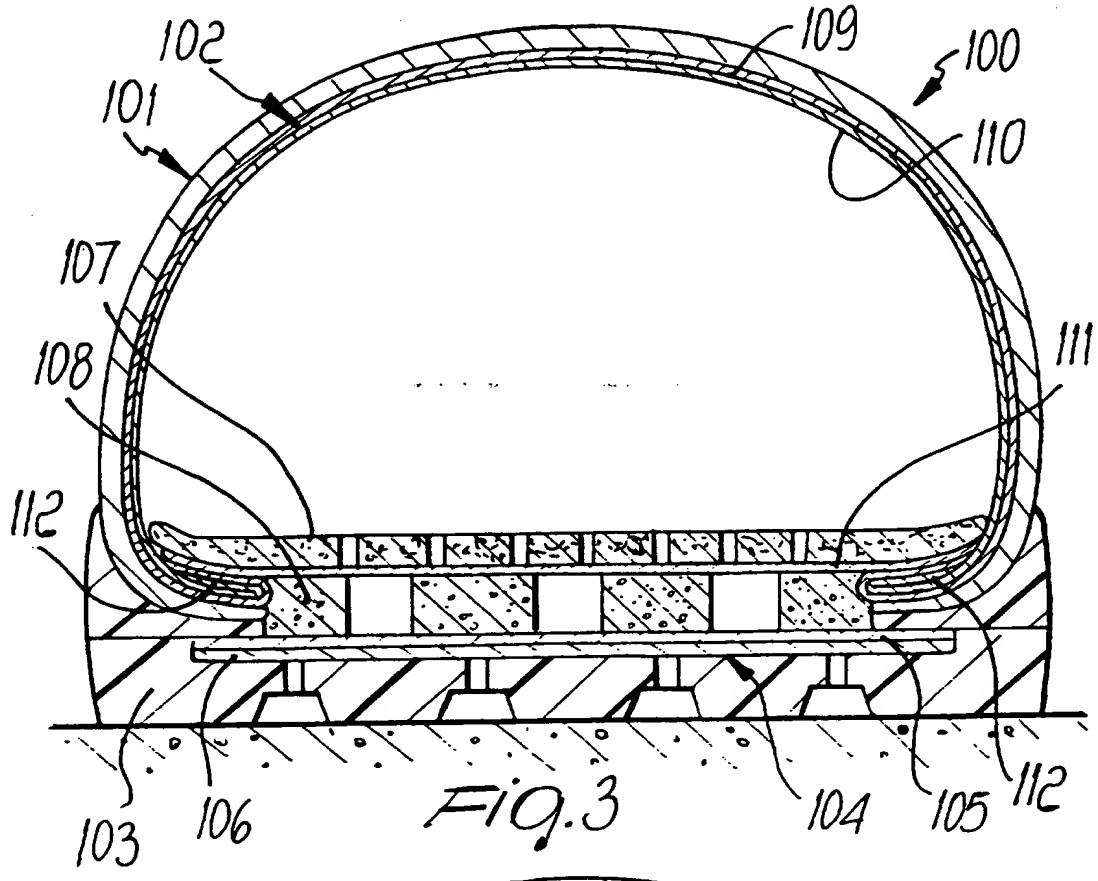
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Fig. 3

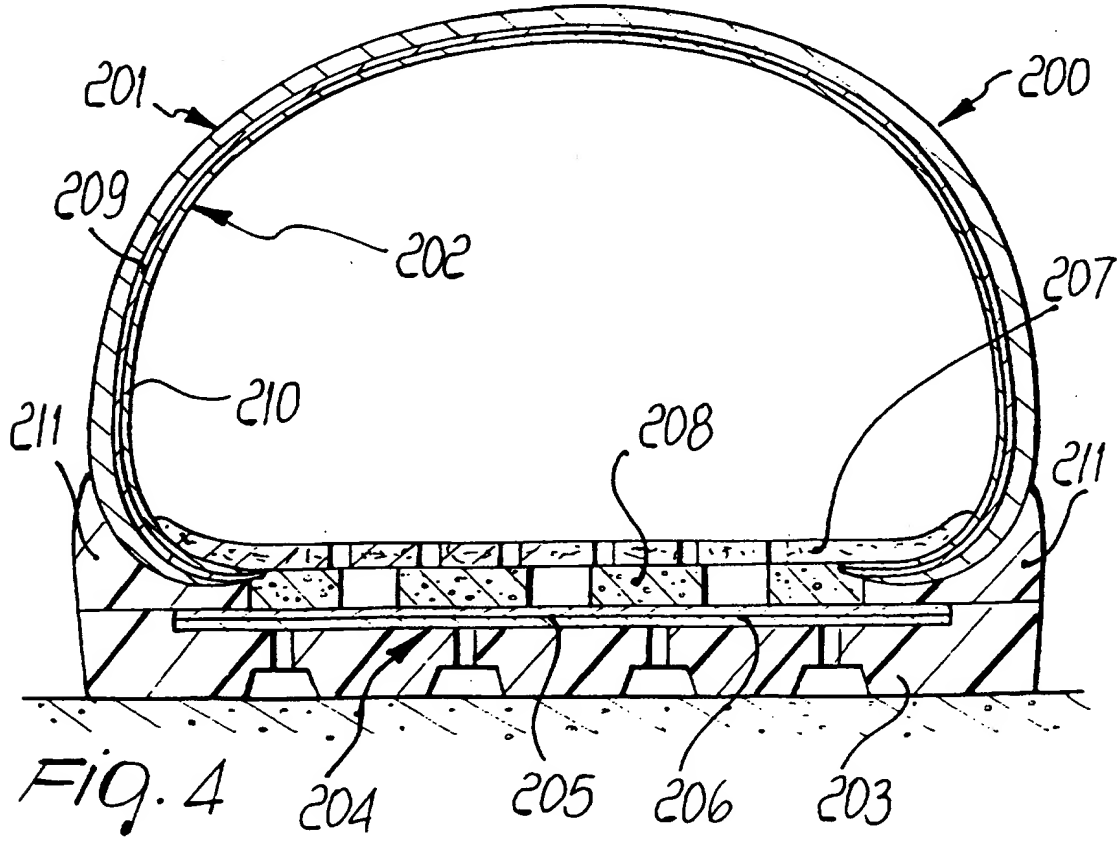
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Fig. 4

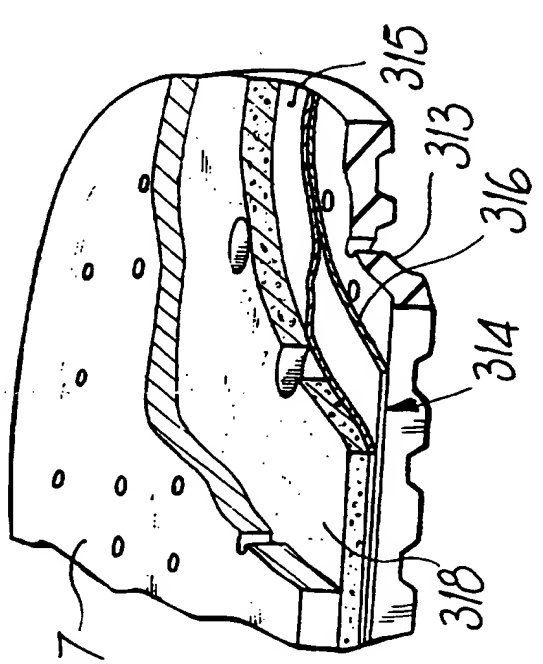

Fig. 6

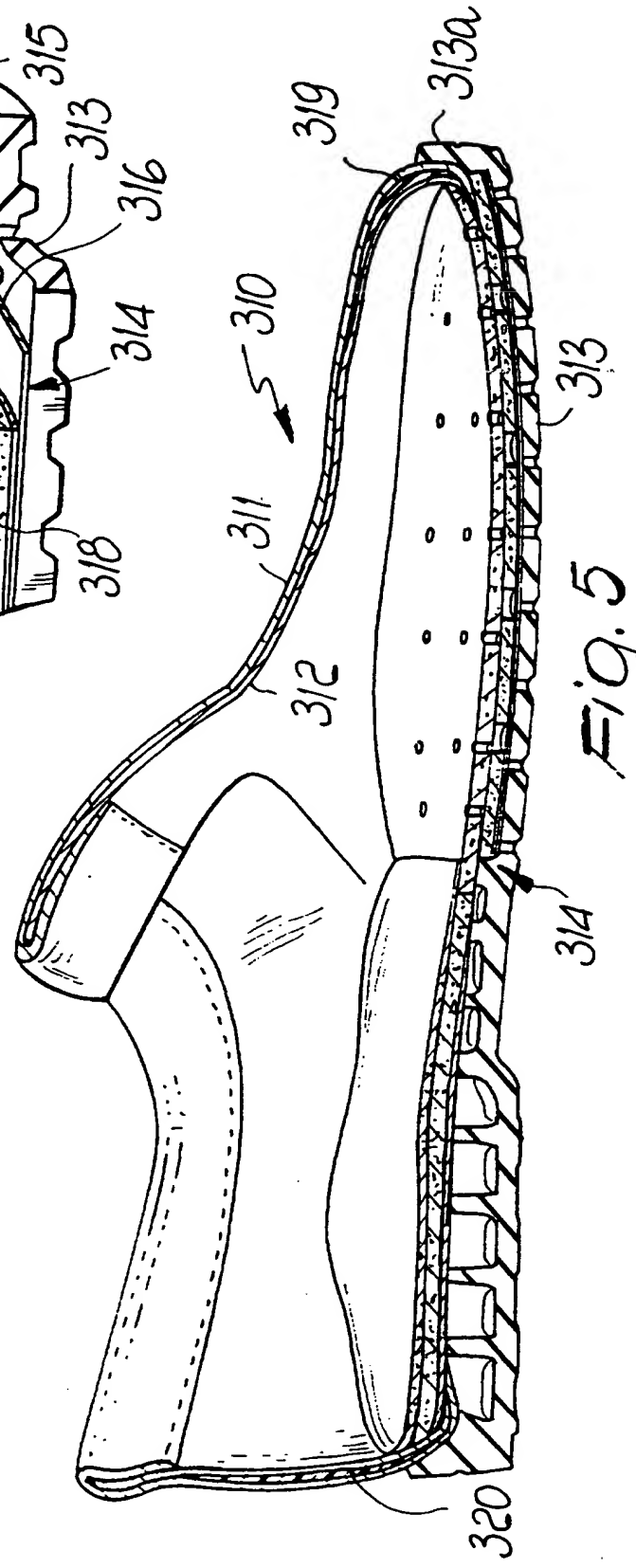

Fig. 5

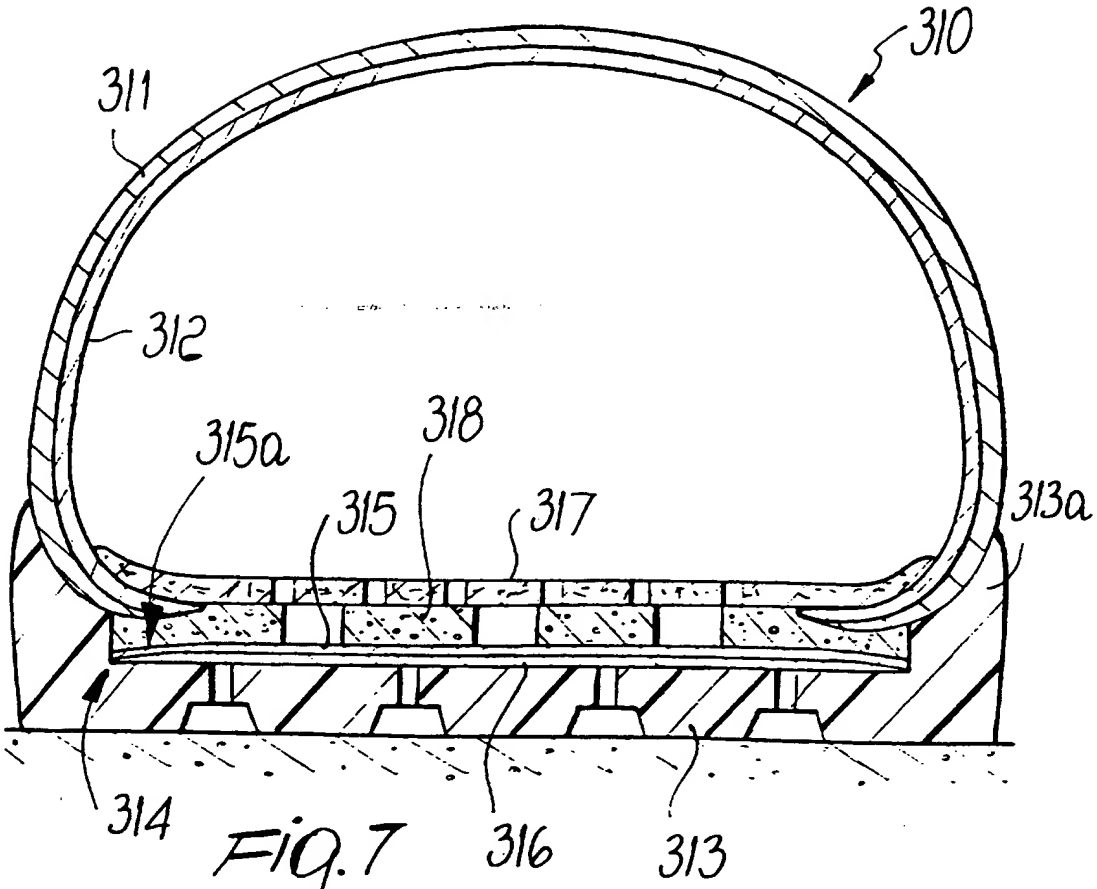
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Fig. 7

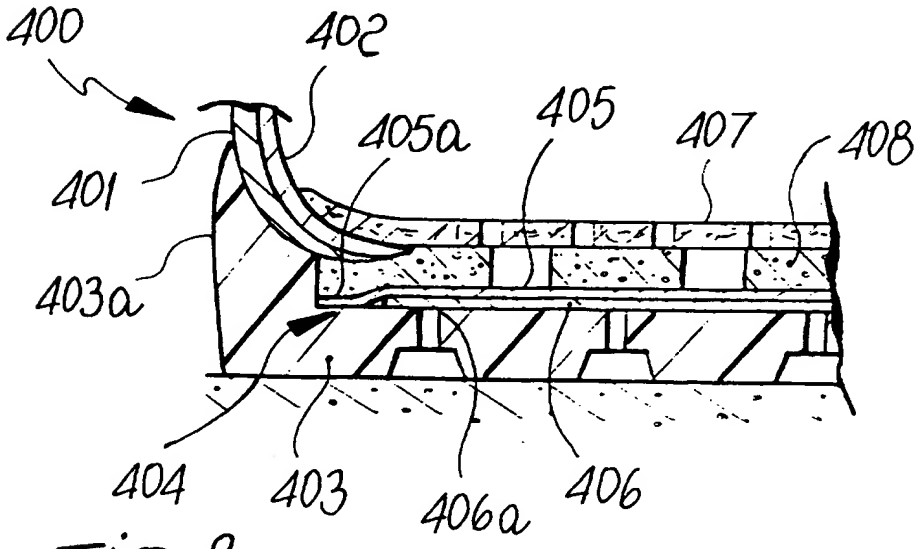
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Fig. 8

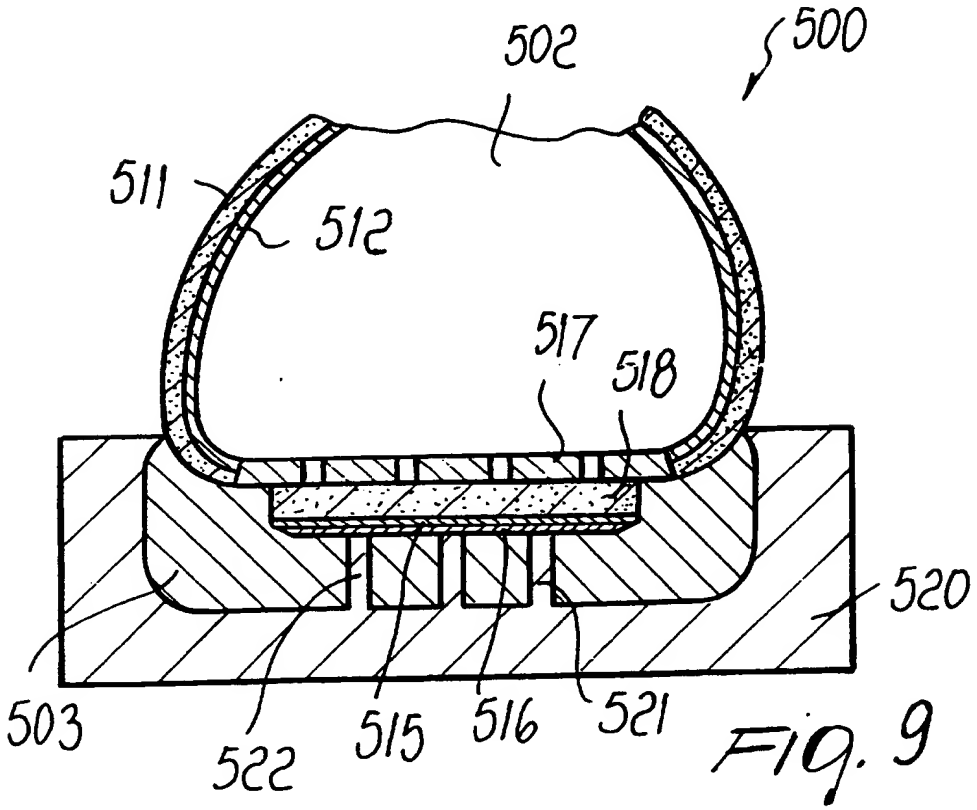
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Fig. 9

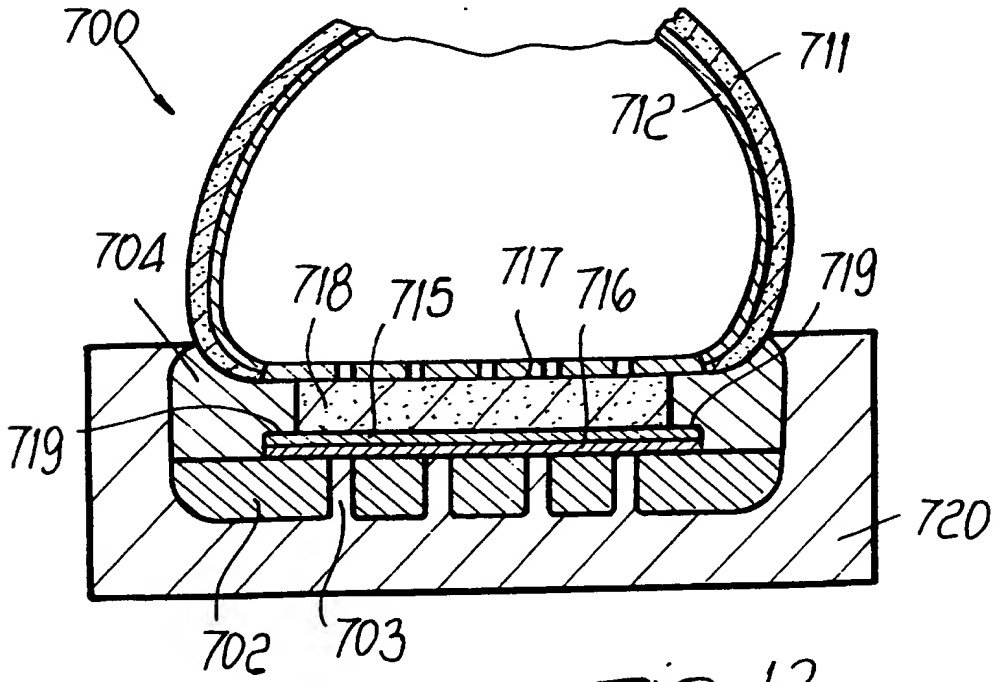
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Fig. 12

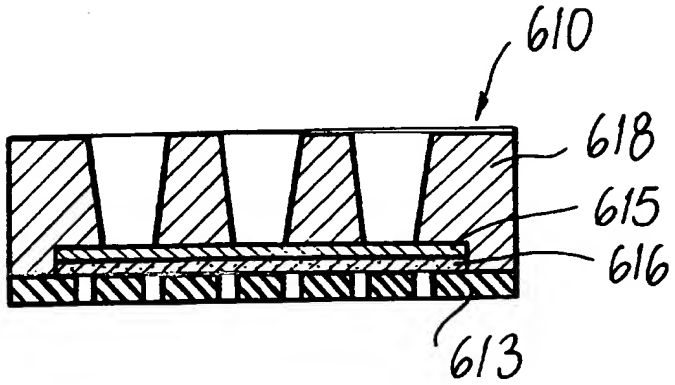

Fig. 10

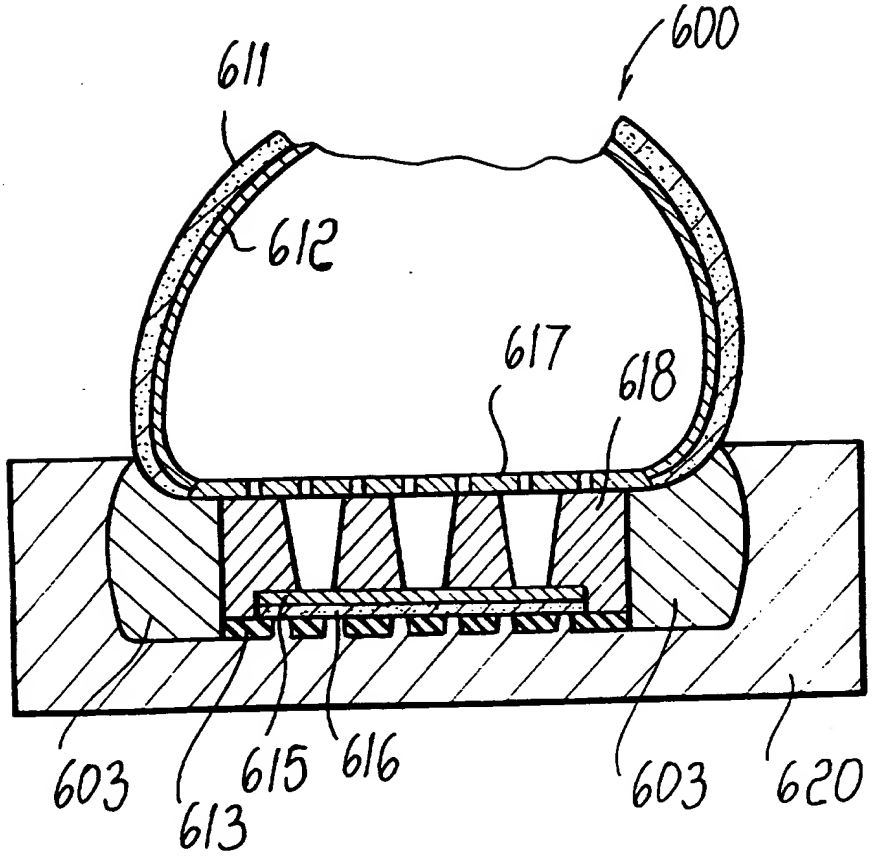

Fig. 11

INTERNATIONAL SEARCH REPORT

Int. ..tional Application No
PCT/EP 96/04382

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 A43B7/12

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 A43B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	EP,A,0 728 424 (GORE W L & ASS SRL) 28 August 1996 see column 2, line 38 - column 3, line 25; claims; figures	1-25
X	EP,A,0 080 710 (GORE W L & CO GMBH) 8 June 1983 see page 3 - page 5, line 19; claims; figures	1,4,6-8, 12-16, 19,23

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
21 January 1997	31.01.97

Name and mailing address of the ISA	Authorized officer
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A		2-6, 8-10,15, 17,18, 20-22, 24,25
A	EP,A,0 275 644 (JAPAN GORE TEX INC) 27 July 1988	
A	US,A,4 899 465 (BLEIMHOFER WALTER ET AL) 13 February 1990 see abstract; figures	20,22, 24,25
A	EP,A,0 382 904 (POL SCARPE SPORTIVE SRL) 22 August 1990	
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1

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inte...ational Application No
PCT/EP 96/04382

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(74) Agent: MODIANO, Guido; Modiano & Associati, Via Meravigli, 16, I–20123 Milano (IT).

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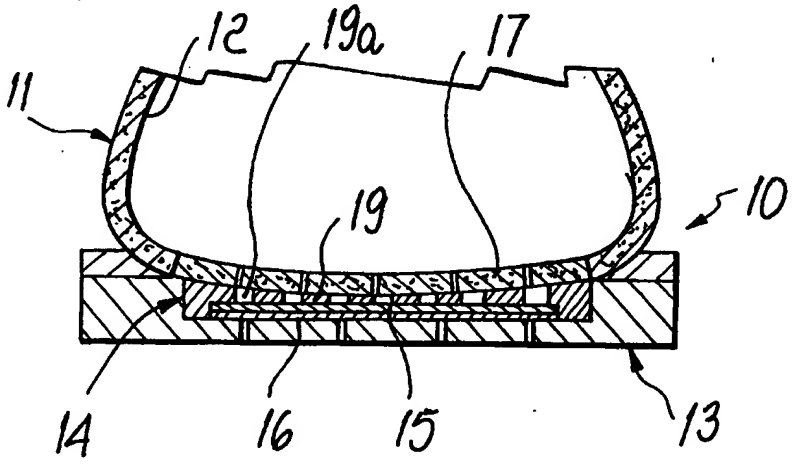
(54) Title: IMPROVED VAPOR–PERMEABLE SHOE



(57) Abstract

A vapor–permeable shoe comprising the following combination of elements: a vapor–permeable upper (11) associated with a vapor–permeable or perforated lining (12); a tread sole (13) made of perforated elastomer; a mid–sole, comprising at least one membrane (15) made of waterproof and vapor–permeable material associated with a lower protective layer (16) made of a material resistant to hydrolysis, the layer being water–repellent, vapor–permeable and/or perforated; a vapor–permeable or perforated insole (17); a vapor–permeable or perforated filler (19) layer arranged between said insole and said membrane. The membrane is associated and sealed, at its edge regions, to a pre–molded insert (14) which is suitable to form a perimetric support for the membrane both during assembly and during use.

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IMPROVED VAPOR-PERMEABLE SHOE

Technical Field

The present invention relates to an improved vapor-permeable shoe.

Background Art

It is currently known that a shoe, in order to be comfortable, must ensure correct exchange of heat and water vapor between the microclimate inside the shoe and the external microclimate.

However, such heat and water-vapor exchanges must not compromise in any case the impermeableness of the shoe to external moisture or water.

In currently commercially available shoes, heat and water-vapor exchanges are substantially entrusted either to the upper portion of the shoe (upper) or to the sole.

As regards the upper portion of the shoe, shoes which have perforated uppers and/or are provided with linings made of vapor-permeable and waterproof material are currently commercially available.

Indeed, in some models, part of the upper may be replaced with materials which are indeed waterproof and at the same time vapor-permeable.

Another category of shoes instead entrusts transpiration to the sole, by using layers of materials which are impermeable to water and are vapor-permeable, optionally associated with protective layers and with fillers.

In order to achieve optimum exchange of heat and water vapor, a vapor-permeable shoe has been conceived which is disclosed in Italian Invention Patent Application No.

PD95A000190 filed on October 13, 1995 and comprises the following combination of elements:

a vapor-permeable upper associated with a vapor-permeable or perforated lining;

a tread sole made of perforated elastomer;

a mid-sole which comprises at least one membrane made of vapor-permeable waterproof material which is associated with a lower protective layer made of a material resistant to hydrolysis, water-repellent and vapor-permeable or perforated;

a vapor-permeable or perforated insole;

a vapor-permeable or perforated filler layer arranged between the insole and the membrane.

In the shoe as disclosed in Italian Invention Patent Application No. PD95A000190 filed on October 13, 1995, the lower part of the upper, the thread sole and the mid-sole with the membrane are perimetrically sealed in their coupling regions. Said shoe has solved the problem of the transpiration of heat and water vapor, but it still entails some marginal drawbacks mostly during manufacture. This is because it is rather difficult to insert the rather delicate waterproof membrane precisely, safely and without damage during the assembly of the mid-sole.

Moreover, during use, the membrane, especially in shoes used in particularly demanding situations, may be subjected to such stresses as to produce undesirable damage thereto.

Disclosure of the Invention

The aim of the present invention is to provide a vapor-permeable shoe which combines the possibility of

providing heat and water-vapor exchange both through the upper and through the sole, ensuring at all times an optimum internal microclimate as a function of the external climate, with improved simplicity and precision of execution during manufacture.

Within the scope of this aim, an object of the present invention is to provide a vapor-permeable shoe in which the membrane specifically assigned to the transpiration function is protected effectively even if the shoe is used in situations which are particularly demanding as to mechanical stresses, such as in the field of sports and in the field of working shoes.

Another object of the present invention is to provide a vapor-permeable shoe which is meant both for day-to-day use and for sports use.

Another object of the present invention is to provide a vapor-permeable shoe having a competitive cost with respect to conventional vapor-permeable shoes.

Another object of the present invention is to provide a vapor-permeable shoe which can be manufactured with known technologies.

This aim, these objects and others which will become apparent hereinafter are achieved by a vapor-permeable shoe comprising the following combination of elements:

a vapor-permeable upper which is associated with a vapor-permeable or perforated lining;

a tread sole made of perforated elastomer;

a mid-sole which comprises at least one membrane made of waterproof and vapor-permeable material which is associated with a lower protective layer made of a material

resistant to hydrolysis, water-repellent and vapor-permeable and/or perforated;

a vapor-permeable or perforated insole;

a vapor-permeable or perforated filler layer arranged between said insole and said membrane,

said shoe being characterized in that said membrane is arranged in a preassembled insert, to which it is sealed at its edge regions, said insert being suitable to provide support for said membrane both during assembly and during use.

This invention also concerns a vapor-permeable, water-repellant or waterproof, preassembled insert capable of being precisely and easily included into a sole assembly during manufacture of a shoe. The insert comprises a vapor-permeable, waterproof membrane having upper and lower faces and an edge face, a vapor-permeable or perforate protective layer adjacent to and in contact with said lower face, and a waterproof supporting grid adjacent to and in contact with said membrane, said supporting grid being bonded to said membrane at least at the periphery of said membrane. The bonding may be accomplished at the perimeter of said upper face of said membrane, at the perimeter of said edge face or at the perimeter of both said upper face and said edge face.

Brief description of the Drawings

Further characteristics and advantages of the vapor-permeable shoe according to the present invention will become apparent from the following detailed description of various embodim nts thereof, illustrated by way of non-limitative example in the accompanying drawings, wherein:

Figure 1 is a transverse sectional view of a shoe according to the invention in a first embodiment;

Figures 2 to 5 are sectional views of respective variations of an insert included within the shoe of Figure 1;

Figure 6 is a sectional view of another variation of the insert and of the tread sole of the shoe of Figure 1;

Figures 7 and 8 are sectional views of possible embodiments of the tread sole including a membrane;

Figure 9 is a transverse sectional view of another variation of the shoe according to the present invention;

Figure 10 is a view of a variation of the tread sole with protective membrane;

Figure 11 is a transverse sectional view of a shoe according to the invention in another embodiment;

Figure 12 is an enlarged-scale view of a detail of Figure 11.

Ways of carrying out the Invention

With particular reference to Figure 1, a vapor-permeable shoe according to the invention is generally designated by the reference numeral 10 in a first embodiment.

In this case, the shoe 10 comprises an upper 11 which is vapor-permeable (for example made of natural hide without sealing pigments), associated with a lining 12 which is vapor-permeable or perforated (for example made of Cambrelle).

The lining 12 is associated with the upper 11 by spot gluing so as to avoid compromising transpiration through said upper.

The shoe 10 further comprises a tread sole 13 made of elastomer, which is perforated in a downward region, and a mid-sole which is generally designated by the reference numeral 14.

In this case, the mid-sole 14 comprises a membrane 15 made of vapor-permeable waterproof, Teflon material, such as those commercially available and known by the trade-name Gore-Tex, associated with a protective layer 16 which is directed towards the tread sole 13 and is made of a material resistant to hydrolysis, water-repellent, vapor-permeable or perforated. Alternatively, the vapor-permeable waterproof material may be polyurethane or a polyester commercially available and known by the trade-name Sympatex.

Membranes used to prepare the vapor-permeable, waterproof material generally have a thickness in the range of 10 to 50 microns. Such membranes are usually sold by the manufacturer as coated large meshed and light "tricots".

Protective layers for the waterproof film may be formed of fast drying non-woven fabric, e.g. polyester having a thickness ranging from 0.8 to 5 millimeters thick. For conventional shoes, a thickness of 1 millimeter is satisfactory. For shoes used in heavy duty applications, such as trekking and working boots, a protective layer thickness of 4 to 5 millimeters or more is satisfactory.

The shoe 10 further comprises, in this case, an insole 17 made of vapor-permeable material (for example natural leather) which is perforated and is optionally associable with a heel seat made of soft hide with absorbent rubber latex, not shown. The insole 17 is applied to the upper 11

through the classic system called "lasting", that is through a "cap-like" matching of a spreaded upper to a last, to which an insole is applied with nails in the area of the sole. Then, through stretching and spreading, the perimetric parts of the upper are glued on those of the insole along the entire perimeter of the insole. In this way, the upper takes the shape of the last. The outsole or tread sole 13 is then applied.

In this first embodiment, according to the invention, the mid-sole 14 is a pre-molded or in any case preassembled insert to which the tread sole 13 is joined by gluing with a perimetric sealing action or by overmolding.

Said insert/mid-sole 14 which in this case comprises not only the membrane 15 and the protective layer 16 but also a supporting/sealing element 19 which affects the upper and edge regions of the membrane 15, has through holes 19a in its upper region and acts as a filler layer.

The membrane 15 and the protective layer 16 are sealed at the edge regions to the element 19, which is made of elastomeric material (for example polyurethane) and is suitable to form a support for said membrane both during assembly and during use. The attachment may be by overmolding without glues. Similar results may be achieved by a) pre-molding or pre-shaping of the element 19 and subsequent waterproof gluing to the membrane 15, b) superinjection or high frequency or ultrasound welding with the help of liquid glues (e.g., single-component, hydrolysis-resistant polyurethane) or solid, thermic- or electro-weldable glues (films).

In this embodiment it is also possible to apply to the

shoe 10 a tip, not shown, which is vapor-permeable or perforated and is associated with the upper 11 by means of spots of glue so as to ensure its transpiration properties.

Likewise, a vapor-permeable or perforated rear counter, also not shown, can be associated with the upper 11 by means of spots of glue.

The upper 11, in this case, is associated with the insole 17 by applying a bond-like layer of glue along the perimeter of the insole.

Limiting the gluing layer to a perimetric band preserves the vapor-permeability of most of the surface of the insole.

Thus, in the shoe 10, the central part of the insole is in fact entirely free of any element which is impermeable to water vapor (i.e., non-vapor-permeable).

The membrane 15 and the lower protective layer 16 are mutually coupled by spot gluing by using an adhesive which is commercially available and is resistant to hydrolysis (a kind commonly known as "hot melt", or systems with calendered powders).

The protective layer 16 can be conveniently made of water-repellent material which is capable of drying quickly. Such material includes for example non-woven fabric, preferably polyester, needle-loomed fabric or Kevlar.

The protective layer 16 is directed downward, i.e., towards the tread sole 13, since it must protect the membrane 15 against external impacts or foreign objects which might penetrate through the holes formed in said tread sole 13.

Moreover, the membrane 15 is substantially sealed perimetrically by the connection to the element 19, which is overmolded thereon during production. Alternatively, the seal can be produced by perimetric gluing of the upper perimetric surface and/or edge of membrane 15 to element 19 with hydrolysis-resistant adhesives.

Therefore, the connection between the membrane 15 and the element 19 occurs either without using adhesives, or with adhesives only in the perimetric part. This affords ample surface of the membrane free of covering or coating so as to permit transpiration of moisture vapors.

Moreover, the entire insert/mid-sole 14 can be provided so as to be modular, being usable for various soles and for various sizes. If desired the inserts may be shaped to accommodate the shape of "left" and "right" shoes.

Moreover, it is noted that the insert/mid-sole 14 is easy to insert in the sole, thus facilitating the positioning of the membrane 15, which can be applied with absolute precision.

Similarly, the tread sole 13 may be shaped to accommodate the insert. Precision in positioning is in fact assisted by the very shape of the insert/mid-sole 14, which is perimetrically shaped substantially complementary to the remaining components of the sole in or between which it must be accommodated.

The assembly of the membrane 15 allows to leave the largest possible vapor-permeable surface without having superimposed el ments th reon, consequently increasing the absorbing capabilities of the membrane 15.

With particular reference to Figure 2, in a constructive different embodiment of the shoe 10 the insert, now designated by the reference numeral 114, comprises a supporting grid 121 above the membrane 115 with the protective layer 116, while the overmolded or superimposed element, now designated by the reference numeral 119, is limited only to the perimetric regions.

The grid 121 gives greater mechanical strength to the shoe, particularly at the insole. If desired the grid 121 may be separately overmolded onto or separately adhered to the membrane or may be an integral portion of superimposed element 114.

With particular reference to Figure 3, in another different embodiment of the shoe 10 the insert, now designated by the reference numeral 214, comprises, above the membrane 215, a felt 222 (or another highly vapor-permeable filler material in other cases) which is applied in the mold or subsequently and has high-level characteristics in terms of vapor-permeability, moisture absorption, physical weight support and thermal insulation from the outside climate; said characteristics are particularly useful for example in winter shoes, where it is necessary to prevent condensation of the water vapor produced by perspiration due to its cooling.

In particular, in shoes meant for cold environments, the felt 222 or the material having similar characteristics can be combined with films or layers of material which are highly insulating and vapor-permeable or suitably perforated to nsure vapor permeability.

In this case too, the overmolded element 219 affects

only the edge regions of the membrane 215 and of the protective element 216.

With reference to Figure 3bis, the filler layer, now designated by the reference numeral 222a (and made for example of felt), is interposed between an upper spacing layer 222b made of hydrophobic material and a lower layer 222c made of hydrophilic material, both of which are perforated or vapor-permeable.

In this manner, an increase in the absorbing capabilities of the membrane, now designated by the reference numeral 215a is achieved, and therefore in the vapor-permeability of the shoe through the sole.

The layer 222b made of hydrophobic material is in fact meant to propel moisture towards the layer 222c made of hydrophilic material which lies close to the membrane 215a on the opposite side with respect to the protective layer 216a, allowing it to absorb said moisture quickly and to expel it outside, preventing the vapor, before passing through the membrane 215a, from condensing into water, which does not pass through and stagnates inside the shoe.

As an alternative, the two hydrophobic and hydrophilic layers can also enclose, in a sandwich-like fashion, other elements arranged between the foot and the membrane (insole, supports located outside the membrane, etcetera).

It is evident from the illustrations set forth in Figures 1,2,3 and 3bis that the supporting/sealing element 19,119,219 may abut the perimetric outer surface of the waterproof membrane, the perimetric edge face of the membrane and the perimetric edge of the protective layer.

With particular reference to Figure 4, in another

different embodiment, in the insert 314 the means for protecting the membrane 315, which is known to be particularly sensitive and susceptible of damage at rough terrain or at foreign objects which can pass through the holes of the tread sole, are constituted, in this case, by one or more elements 316 made of open-cell plastics (for example, materials such as polyurethane or polyethylene or polyester are commercially available), which can offer great resistance to perforation by virtue of their thickness, rigidity and physical characteristics.

The element 316 is also provided in practice with through holes having various orientations, so as to prevent foreign objects from making contact with the membrane 315.

The insert 314 is completed along its perimeter by an element 319 which is overmolded or superimposed like the preceding ones.

With particular reference to Figure 5, in a further embodiment of the insert, now designated by the reference numeral 414, the means for protecting the membrane 415 are constituted by one or more elements 416 made of felt which is in turn constituted by fibers resistant to perforation, such as aramid fibers or equivalent fibers.

In this case too, the insert 414 is completed by an element 419 which is overmolded or superimposed.

Figure 6 depicts another embodiment of the insert, now designated by the reference numeral 514, it has a sandwich-like structure which comprises two external membranes 515a and 515b made of waterproof and vapor-permeable material and between which a vapor-p rmeable and/or perforated structural supporting element 516 is pack d.

The membranes 515a and 515b are mutually glued with water-resistant adhesives so as to form a perimetric seal. In this embodiment, in particular, the membrane 515b is more exposed than the other to any damaging action; however, the more protected membrane 515a in any case ensures vapor permeability and yet provides waterproofing of the shoe as a whole, while the other membrane is protected to a certain extent by optional contouring of the tread sole, designated by the reference numeral 513 in this case, to which it is perimetrically sealed or which is overmolded or superimposed thereon.

In particular, optional protective contours of the tread sole are visible in Figures 7 and 8, which show two tread soles, designated by the reference numerals 613a and 613b respectively, in which the holes, designated by the reference numerals 620a and 620b respectively, are spaced from the region that is in contact with the ground for example by increasing the thickness of the pattern of said tread sole but not the minimum thickness of the material in the perforation points.

The reference numerals 615a and 615b designate the respective membranes.

It should also be noted that in further embodiments the pre-molded insert can also comprise portions of the tread sole.

With particular reference to Figure 9, a constructive variation of the shoe is fully similar to the shoe 10 and is thus generally designated by the reference numeral 700.

In this embodiment, the shoe 700 is provided with means for protecting the membrane 715, which are

constituted by a composite tread sole 713.

In particular, the tread sole 713 comprises a waterproof layer 713a, which is in contact with the ground, and an internal layer 713b, which is made of microporous and fully permeable material.

In particular, said layer 713b makes contact with, or in any case faces, the membrane 715, to which it is joined at least in the edge regions (where a seal is provided) by means of an element 720 which joins the entire assembly to the upper 711.

The layer 715b is fully permeable and thus allows the transpiration of water vapor and heat exchange through its edge regions (the other regions are sealed by the lower layer 715a).

The shoe has, above the membrane 715 as well, a filler layer 719 which is vapor-permeable or perforated and a vapor-permeable or perforated insole 717.

With particular reference to Figure 10, a tread sole in a further embodiment is generally designated by the reference numeral 813.

The tread sole 813 has a structure which is substantially similar to the tread sole 13; however, it differs from said structure in that it comprises a membrane 815 which is made of vapor-permeable and waterproof material and is applied to a lower protective layer 816.

The membrane 815 and the protective layer 816 are folded and sealed perimetrically directly to the tread sole 813, which is in any case perforated.

In this case, th refore, the membrane 815 is sealed directly to the tread sole 813.

Coupling to the remaining parts is provided for example as in the cas of the shoe 700.

With particular reference to Figures 11 and 12, a shoe according to the invention, in another embodiment, is generally designated by the reference numeral 900.

The shoe 900 is particularly suitable for safety applications in work subjected to the risk of intense continuous or momentary stresses affecting the feet.

In particular, the shoe 900 has a structure which is substantially similar to the shoe 10, but it differs from the latter in that it comprises a metallic element 902 which is inserted in the mid-sole, designated by the reference numeral 901 in this case, which is contoured and corrugated so as to increase its structural strength and is provided with holes 903 in which the axis is substantially parallel to the ground and which allow continuity of the vapor-permeability of the shoe 900 as a whole.

As an alternative to the metallic material it is possible to use a different material having the same strength characteristics, such as carbon fiber, fiber-reinforced plastics, etcetera.

In particular, in this case the metallic element 902 is arranged directly below a membrane 915 which is meant to simultaneously provide the vapor-permeable and waterproofing function.

The membrane 915, together with the corrugated element 902, a lower filtering element 917 and a portion 919a of perforated tread sole 913 which is overmolded and seals the perimetric regions, are part of a pre-molded or superimposed insert 914.

An upper filler layer 918 is provided.

The assembly is joined to the rest of the shoe 900 by means of the remaining (perimetric) portion 919b of the tread sole 913, which is overmolded or superimposed.

Vapor-permeability in this shoe occurs for example along the path of the double arrow 920.

In practice, it has been observed that the present invention, in its various embodiments and variations, achieves the intended aim and objects.

In particular, it should be noted that the shoe and insert according to the invention substantially completely solve any difficulties in positioning the membrane during manufacture.

Moreover, the shoe and insert according to the invention also provide for adequate protection of said membrane; accordingly, shoes so prepared can be used also for particularly demanding applications, as for example in the sports field or in the field of safety footwear.

It should also be noted that membrane protection is achieved without compromising in any way the vapor-permeability and waterproofing characteristics of the shoe as a whole.

Attention is also drawn to the flexibility of use of the shoe according to the invention and to the possibility of providing said shoe at costs which are highly competitive with respect to conventional shoes.

It should also be noted that the shoe according to the invention, thanks to its shape and constructive structure, can also be suitable for high-quality embodiments.

The present invention is susceptible of modifications

and variations, all of which are within the scope of the inventive concept; th materials may also be any according to requirements.

Obviously, numerous modifications and variations of the present invention are possible in light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described herein.

This application claims priority of Italian Application No. PD97A000102 filed May 9, 1997, the entire specification of which is incorporated herein by reference.

CLAIMS

1. A vapor-permeable shoe comprising the following combination of elements:

a vapor-permeable upper associated with a vapor-permeable or perforated lining;

a tread sole made of perforated elastomer;

a mid-sole which comprises at least one membrane made of waterproof and vapor-permeable material associated with a lower protective layer made of a material resistant to hydrolysis, water-repellent, vapor-permeable and/or perforated;

a vapor-permeable or perforated insole;

a vapor-permeable or perforated filler layer arranged between said insole and said membrane,

said shoe being characterized in that said membrane, together with said protective layer, is arranged in a preassembled insert, to which it is sealed at its perimetric regions, said insert being suitable to form a support for said membrane both during assembly and during use.

2. A shoe according to claim 1, characterized in that said insert is pre-molded.

3. A shoe according to claim 1, characterized in that said insert comprises, at least in its perimetric regions, an element made of plastics which is overmolded on the membrane and protective layer components of said insert.

4. A shoe according to claim 1, characterized in that said insert comprises, above said membrane, a grid which supports said insole and constitutes said filler layer.

5. A shoe according to claim 1, characterized in that said insert comprises, above said membrane, an element made of vapor-permeable felt which constitutes said filler layer, absorbs moisture, has good mechanical characteristics and provides thermal insulation from the outside climate.

6. A shoe according to claim 1, characterized in that layers of material are provided above said membrane, said layers comprising an upper layer of hydrophobic material and a lower hydrophilic layer, both of which are vapor-permeable or perforated.

7. A shoe according to claim 6, characterized in that a spacer layer is interposed between said layers made of hydrophobic and hydrophilic material.

8. A shoe according to claim 1, characterized in that said protective layer comprises one or more elements which are associated below said membrane, are shaped complementary thereto and are made of microperforated open-cell plastic material.

9. A shoe according to claim 1, characterized in that said protective layer of said membrane comprises one or more felts associated below said membrane and made of vapor-permeable textile materials which are resistant to mechanical stresses.

10. A shoe according to claim 1, characterized in that said insert is constituted by two membranes made of vapor-permeable and waterproof material, between which an internal structural stiffening layer is interposed, said membranes being sealed together and to the tread sole at the perimetric regions.

11. A shoe according to claim 1, characterized in that said insert comprises portions of said tread sole.

12. A shoe according to claim 1, characterized in that said insert comprises, directly below said membrane, a structural supporting element which has a corrugated cross-section and is provided with transverse holes that ensure the continuity of the overall vapor-permeability of said shoe.

13. A shoe according to claim 12, characterized in that said insert comprises in succession, from top to bottom, said membrane, said structural supporting element, a filtering element and a tread sole portion.

14. A shoe according to claim 1, characterized in that said structural supporting element is made of a material selected from the group consisting of metal, carbon fiber composite and fiber reinforced plastic composite.

15. A shoe comprising the following combination of elements:

a vapor-permeable upper which is associated with a vapor-permeable or perforated lining;

a tread sole;

a mid-sole, which comprises at least one membrane made of waterproof and vapor-permeable material associated with a lower protective layer made of a material resistant to hydrolysis, water-repellent, vapor-permeable and/or perforated;

a vapor-permeable or perforated insole;

a vapor-permeable or p rforated filler layer which is arranged betw en said insole and said membrane,

characterized in that said tread sole is a composite

having a lower tough and waterproof layer which is in contact with the ground during use and an upper r gion having a layer permeable to heat and moisture which faces said membrane upon assembly, said permeable layer allowing transpiration through its perimetric edge in contact with the outside.

16. A shoe comprising the following combination of elements:

a vapor-permeable upper associated with a vapor-permeable or perforated lining;

a tread sole made of perforated elastomer;

a mid-sole, which comprises at least one membrane made of waterproof and vapor-permeable material associated with a lower protective layer made of a material which is resistant to hydrolysis, water-repellent, vapor-permeable and/or perforated;

a vapor-permeable or perforated insole;

a vapor-permeable or perforated filler layer which is arranged between said insole and said membrane,

characterized in that said membrane and said protective layer are folded inwardly at the perimetric regions and said membrane is directly sealed to the tread sole.

17. An insert for use in the sole portion of a vapor-permeable shoe, said insert comprising

(i) a membrane made of waterproof and vapor-permeable material having an upper surface, which faces in the direction of a shoe insole, a lower surface which faces in the direction of a shoe sole tread, and an outer edg

(ii) a protective layer located adjacent to the lower

surface of said membrane, and

(iii) a support element locat d at a peripheral portion of said membrane;

said membrane having a peripheral portion which comprises (a) that portion of the upper surface adjacent the outer edge, (b) the outer edge, (c) that portion of the lower surface of said membrane adjacent the outer edge, or combinations thereof;

said support element being bonded to said membrane such that a waterproof bond is formed between the peripheral portion of said membrane and the support whereby said membrane is sealed at its periphery to said support layer.

18. An insert as set forth in claim 17, wherein said protective layer is spot-bonded to said membrane.

19. An insert as set forth in claim 18, wherein said protective layer is comprised of textile materials resistant to mechanical stress.

20. An insert as set forth in claim 17, wherein said support element is overmolded on said membrane.

21. An insert as set forth in claim 17, wherein said support element is bonded to said membrane by gluing.

22. An insert as set forth in claim 17, wherein said insert further comprises a support grid portion bonded to the top surface of said membrane.

23. An insert as set forth in claim 22, wherein said support grid and said support element are integral with each other.

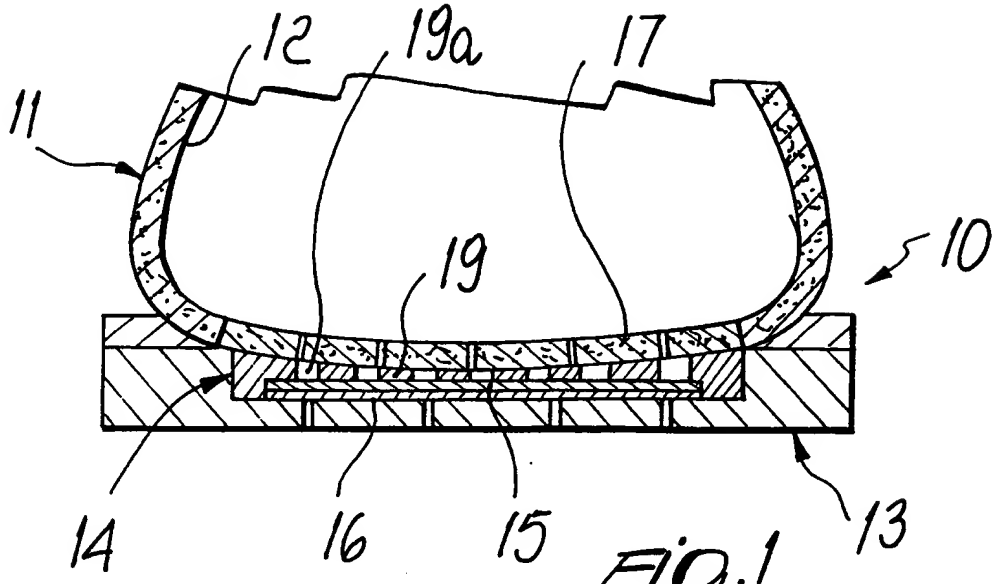


Fig.1

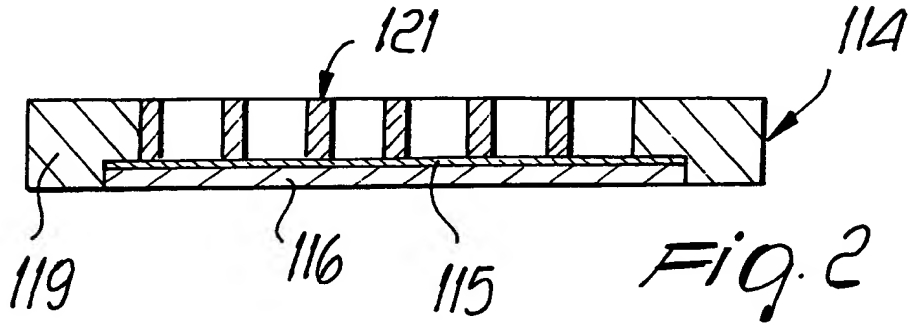


Fig.2

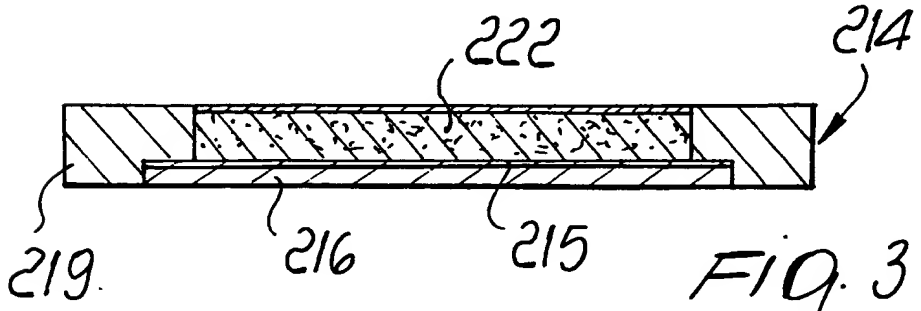


Fig.3

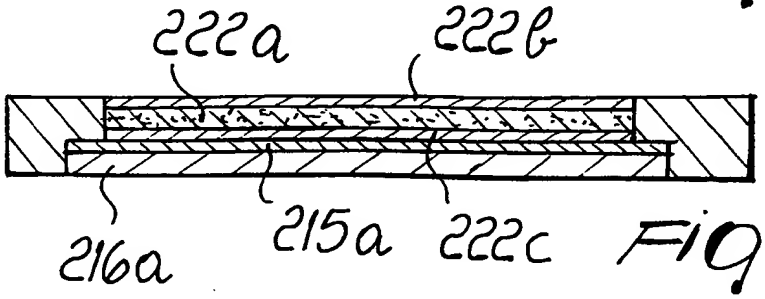


Fig.3bis

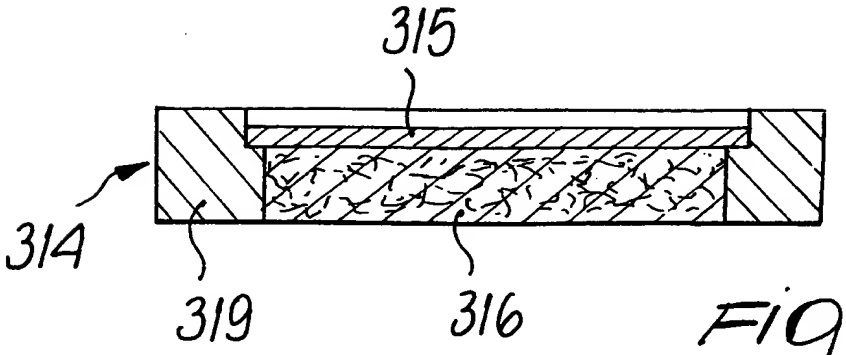


FIG. 4

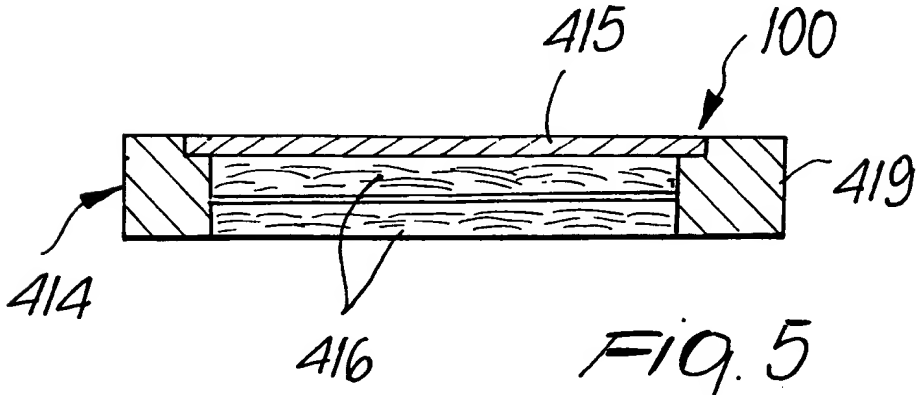


FIG. 5

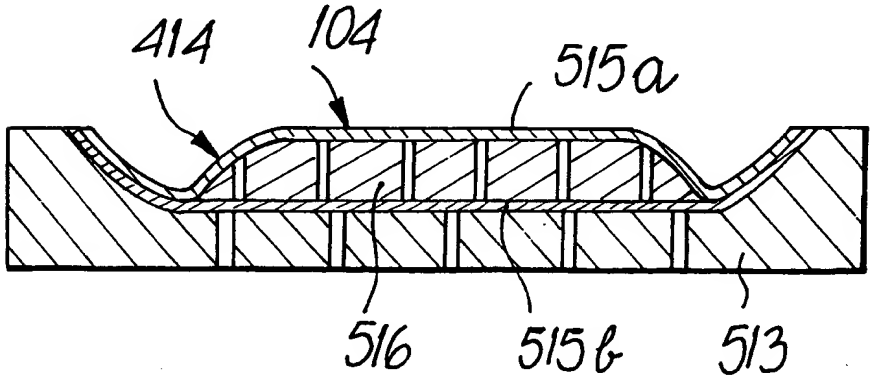


FIG. 6

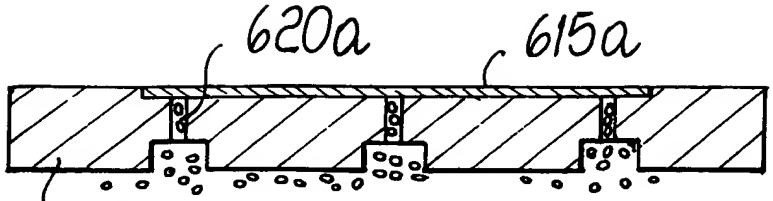


Fig. 7

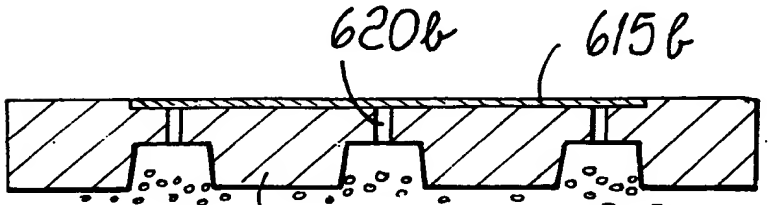


Fig. 8

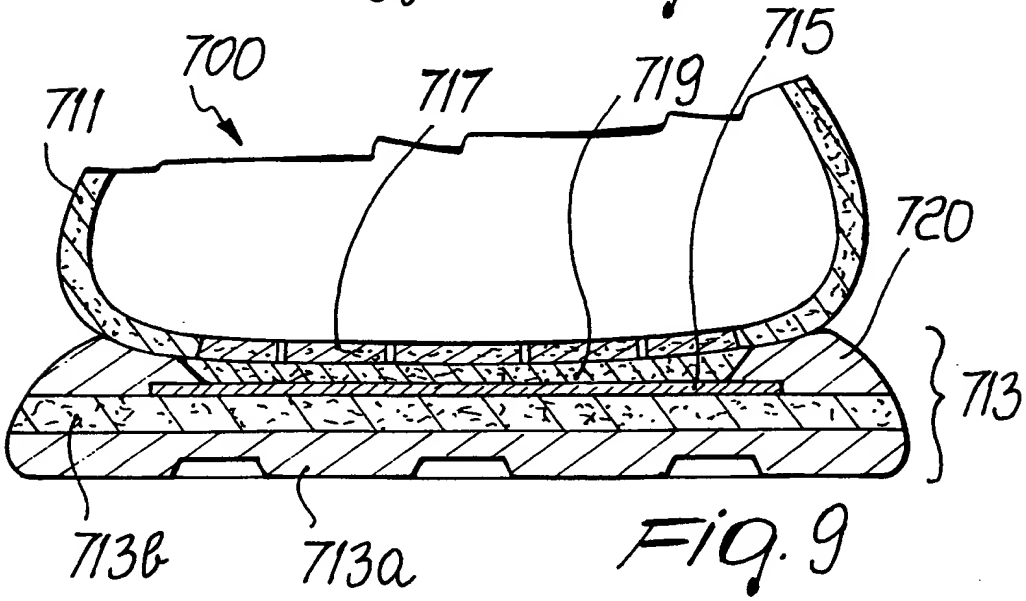


Fig. 9

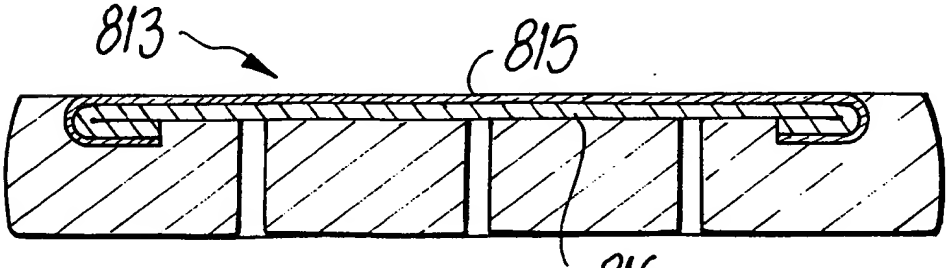
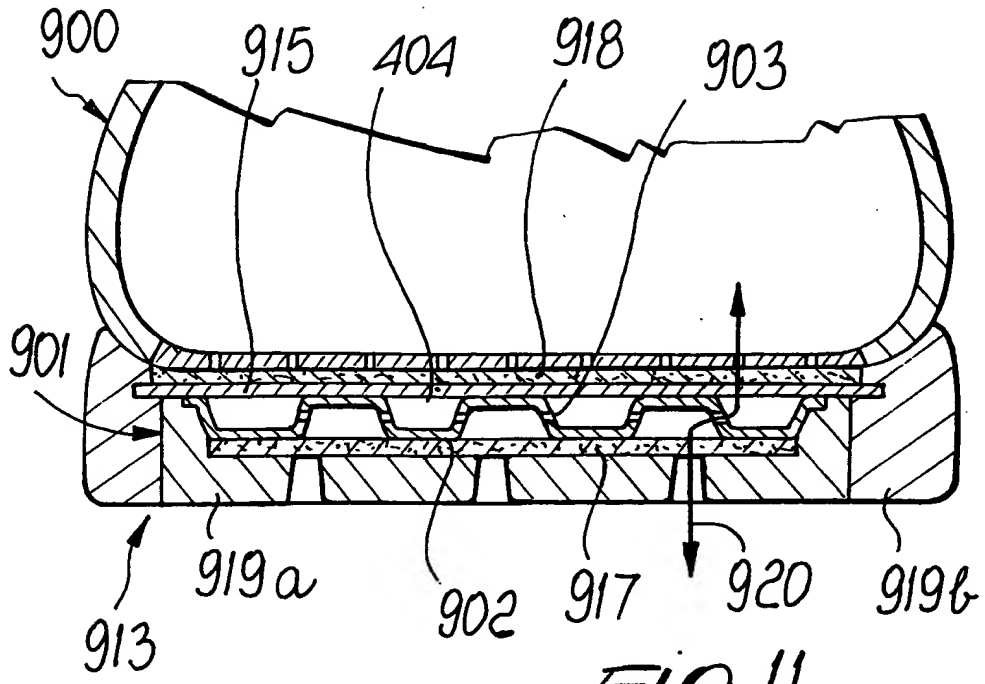


Fig. 10


900
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918
903
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913
919a
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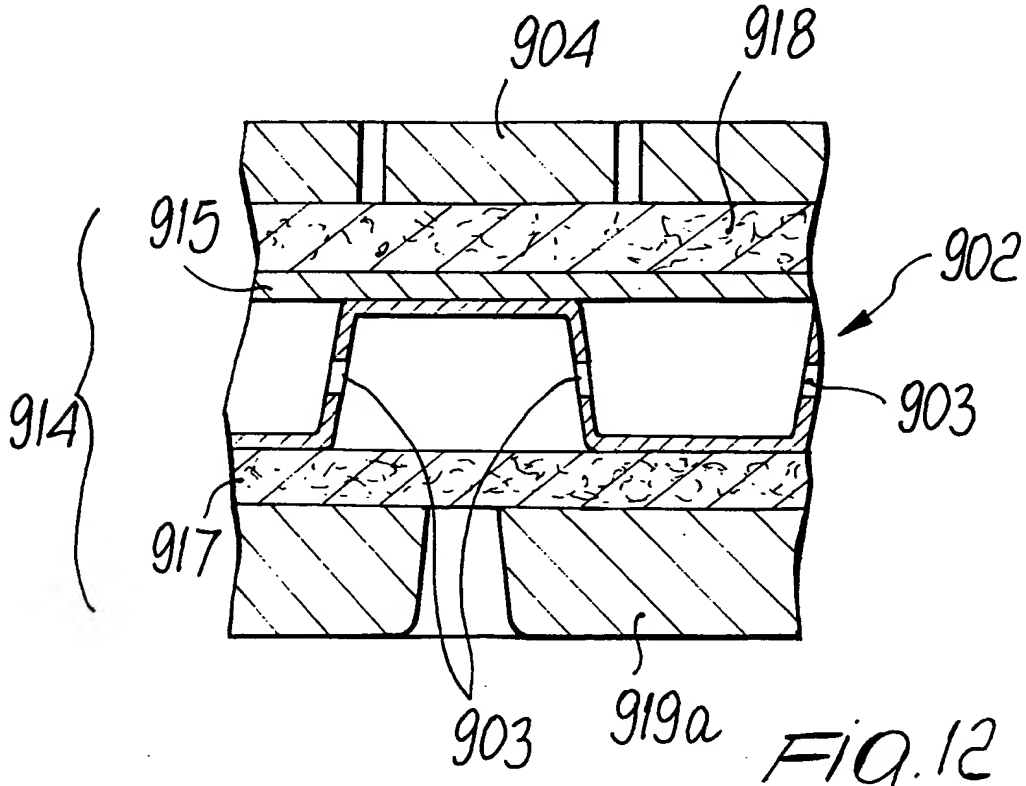
917
920
919b

FIG. 11


904
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914
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917
903
919a

FIG. 12

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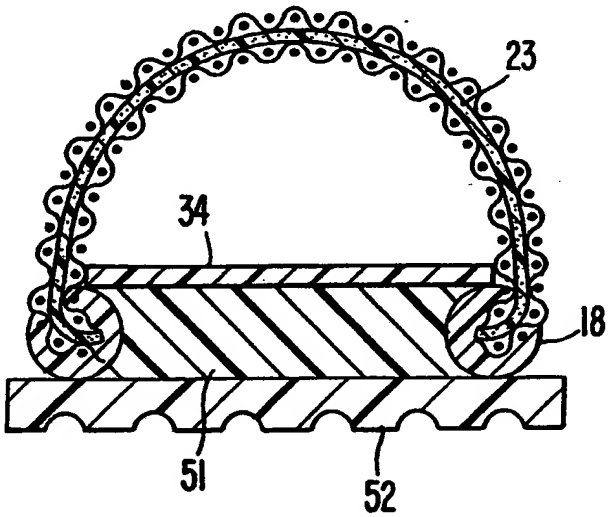
(54) Title: WATERPROOF FOOTWEAR



(57) Abstract

An article f waterproof footwear and its method of manufacture are disclosed. The article f waterproof footwear has an upper containing a water-impermeable layer (23). The distal edge f the upper has a polymeric binding (18) covering the distal edge and the inside and outside surfaces f the upper adjacent to the distal edge. The polymeric binding (18) seals to a waterproof insole (34) thereby effectively waterproofing the upper of the footwear. An outer sole (52) is attached to the upper thereby forming the waterproof footwear. The method f manufacture allows production of a waterproof upper and the attachment to the upper of an outer sole, thereby forming the waterproof footwear of the inventi n.

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WATERPROOF FOOTWEAR

FIELD OF THE INVENTION

This invention relates to waterproof footwear and the method of the manufacture thereof.

BACKGROUND

In order to produce waterproof footwear, footwear is manufactured totally from rubber or another polymer through a dipping or molding technique, such that there is no separation between the upper and the outer sole, and therefore the footwear is water-impermeable. However, waterproof footwear produced through a dipping or molding technique has poor fit, is heavy in weight, and is impermeable to water vapor. Additionally, waterproof footwear produced through a dipping or molding technique is not readily adaptable to various footwear styles.

In recent times, footwear was manufactured whose body or upper part consists of water-impermeable, and preferably, water vapor-permeable material. There have been problems in providing a waterproof connection between the upper and an outer sole of the footwear while still maintaining the good fit, lightweight, and water vapor-permeable quality of the upper material.

In an attempt to produce waterproof footwear whose upper part consists of water-impermeable and water vapor-permeable material, a cement process of lasting footwear was developed. In this process, an upper of a shoe is cemented to an insole. To this unit, a sole is applied which may be an intermediate sole or an outer sole. It is a problem to have truly waterproof footwear with cement-lasted footwear, even if a water-impermeable outer sole and a water-impermeable upper layer are utilized in the construction. The weak point in the production of waterproof cement-lasted footwear is the formation of a durable waterproof seal between the insole and the upper since the lasting cement does not initially seal between the upper and the insole and may become brittle and more water-permeable due to bending stresses

during use of the footwear. The formation of a durable waterproof seal between the insole and the upper is hampered in the lasting process since pleats form in the edges of the upper materials because the straight edges of the upper are forced to lay flat against the curved insole. These upper wrinkles are three-dimensional in nature and therefore provide easy routes for water entry into the upper of the footwear.

To overcome problems with the cement process of lasting footwear, a waterproof insert method was developed wherein a unit of a footwear upper and a cemented insole is lined with a sock-like insert of a water impermeable, water vapor-permeable material, as taught in USP 4,599,810, to Sacre. To obtain an insert that is waterproof and of the desired shape, the insert must first be sewn and then hot-welded at the sewn seams to form a waterproof article. This waterproof insert method does not allow the insole to be directly attached to a shoe last in a single step as in the traditional cement process of lasting footwear. An additional lasting step is usually required by this method, making this method more complicated and expensive for most shoe manufacturers.

An injection molding process for the soling of footwear, as taught in USP 4,899,465 to Bleimhofer, et al., has been used to produce waterproof footwear. A polyurethane outer sole is molded by machine to the sole region of an upper. It is necessary to have an injection mold that is applied to the upper from both sides. This injection mold is relatively expensive. Due to the high mold costs, the shoe manufacturers are restricted to very few sole configurations. Besides, it is not possible to achieve footwear having an elegant appearance with such molded-on outer soles.

The instant invention is directed to an improvement of the cement process of lasting footwear in such a manner that the connection between the upper of the footwear and insole region is waterproof in a reliable manner, while permitting any kind of outer soles to be employed.

SUMMARY OF THE INVENTION

An article of waterproof footwear is provided which includes an upper containing a water-impermeable layer, a proximal opening for receiving a wearer's foot, a proximal edge surrounding the proximal opening, a distal opening, a distal edge surrounding the distal opening. A polymeric binding is adhered to the distal edge of the upper and covers a portion of the inside and outside surfaces of the upper adjacent to the distal edge. A waterproof insole having a top surface for supporting the wearer's foot and a bottom surface sealed to the polymeric binding. An outer sole is subsequently attached to provide a functional article of footwear.

The method for producing the above-described waterproof footwear is also described.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 depicts an upper of the instant invention.

Figure 2 depicts a cross-section of the upper of Figure 1.

Figure 3 depicts a cross-section of an upper of the instant invention placed over a shoe last.

Figure 4 depicts an upper of the instant invention placed over a shoe last.

Figure 5 depicts a cross-section of a shoe of the instant invention.

Figure 6 depicts a cross-section of a shoe of the instant invention having an upper shell adhered to an outer sole.

Figure 7 depicts a cross-section of a shoe of the instant invention having an upper shell stitched to an outer sole.

DETAILED DESCRIPTION OF THE INVENTION

The invention provides for an article of waterproof footwear, more particularly, an article of footwear comprising an upper

having a water-impermeable layer. The upper has a proximal opening for receiving a wearer's foot, a distal opening having a distal edge covered in a polymeric binding and closed by a waterproof insole sealed in a waterproof manner to the polymeric binding. An outer sole is attached to provide a surface capable of contacting a ground surface to form a functional article of footwear.

The term "footwear" is used throughout to refer to any product intended to be worn on the foot and produced by the footwear industry. As such it should not be read to be particularly limiting and is intended to include footwear such as shoes, boots, soft footwear and slippers.

Referring to Figure 1, an upper 11 is depicted. The upper 11 has a proximal opening 12 which is capable of receiving a wearer's foot. The upper 11 has a proximal edge 13 surrounding the proximal opening 12. The upper 11 has an inside surface 16 and an outside surface 17. The upper 11 has a distal opening 14 having a distal edge 15. Upon the distal edge 15 and in those areas of the inside and outside surfaces of the upper adjacent to the distal edge, a polymeric binding 18 is attached.

Referring to Figure 2, a cross-section of upper 11 of Figure 1 taken along line 19 is depicted. In Figure 2, an inside surface material 21 of the upper and an outside surface material 22 of the upper are clearly depicted. The distal edge 15 of the upper as well as inside surface material 21 adjacent to the distal edge 15 and outside surface material 22 adjacent to the distal edge 15 which are covered by the polymeric binding 18 are also clearly depicted.

The upper may be fabricated of various materials including leathers, artificial leathers, or fabrics and laminates thereof. It is preferable that the upper be breathable so as to allow moisture trapped within the article of footwear to escape through the material. A material is defined as breathable if it permits the passage of at least 50 g/(m^2 x 24 hr.) of water vapor in the WVTR test described herein.

Still referring to Figure 2, the upper is comprised of a water-impermeable layer 23. The water-impermeable layer 23 may be laminated to an outside surface material 22 by any number of known laminating means thereby forming a laminated upper. Alternatively, the water-impermeable layer 23 may be attached to the outside surface material 22 only at seams contained in the upper and therefore remain as a distinct layer from the outside surface material. An inside surface material 21 of the upper may also be laminated to the water-impermeable layer 23 by any number of known laminating means, thereby forming a laminated upper. Alternatively, the inside surface material 21 may be attached to the water-impermeable layer 23 only at seams contained in the upper therefore remaining as a distinct layer from the water-impermeable layer.

The water-impermeable layer may be comprised of a layer of a polymeric material. Polymeric materials may be selected from the group consisting of polytetrafluoroethylene (PTFE), polyvinyl chloride, natural rubber, synthetic rubbers, polyester, polyamide, polyurethane, polyethylene and polypropylene. Alternatively, the water-impermeable layer may be a layer selected from the group consisting of waterproof leather, waterproof artificial leather and waterproof fabric.

It is preferable that the water-impermeable layer be a breathable polymeric membrane. Breathable polymeric membranes may be breathable by virtue of pores in the breathable polymeric membrane or through a solution diffusion mechanism. Breathable polymeric membranes may be selected from the group consisting of polyurethane, polyester, polyethers, polyamides, polyacrylates, copolyether esters and copolyether amides. Preferably a water-impermeable breathable polymeric membrane is a membrane of microporous PTFE, more preferably a membrane of expanded microporous PTFE as taught in USP Nos. 3,953,566, and 4,187,390 to Gore and incorporated herein by reference.

The inside surface material of the upper may be leather, artificial leather, or fabric. Preferably, the inside surface material would be of a breathable material as per the previously

disclosed definition.

The outside surface material of the upper may be leather, artificial leather, or fabric. Preferably, the outside surface material would be of a breathable material as per the previously disclosed definition.

Still referring to Figure 2, the polymeric binding 18 is placed on the distal edge 15 and on the inside and outside surface materials, 21 and 22 respectively, of the upper adjacent to the distal edge.

The polymeric binding may be of any material that thoroughly wets and adheres to the distal edge and adjacent surfaces of the upper. The polymeric binding may be polyurethane, natural latex rubber, nitrile rubber, silicone rubber, butyl rubber, fluorinated rubber, copolyether polyester, polyester, ethylene vinyl acetate or polyamide. The polymeric binding may be in the form of a solid material or a foamed material. Preferably, the polymeric binding is a thermoplastic material. Preferably, the polymeric binding is a material having a hardness value less than or equal to 55 D Durometer and greater than or equal to 5 D Durometer, as measured by the test method described herein. More preferable, the polymeric binding is a material having a hardness value less than or equal to 45 D Durometer and greater than or equal to 30 D Durometer.

The polymeric binding may be applied to the distal edge and adjacent surfaces of the upper through various application means. The polymeric binding may be extruded onto the distal edge of the upper. The polymeric material may be dissolved in an appropriate solvent and applied to the distal edge and adjacent surfaces of the upper forming the polymeric binding through brushing, dipping or spraying. The polymeric material may be produced in a tape, sheet or channel form and the tape, sheet or channel form melted onto the distal edge and adjacent surfaces of the upper. A preferred mode of application of the polymeric binding to the upper is to apply the polymeric material through the use of a pair of nipped rollers which are capable of delivering a controlled amount of liquified polymeric material to both the inside and the

outside surfaces, as well as the distal edge, of the upper.

Referring now to Figure 3, the upper 11 with the polymeric binding 18 is positioned on a shoe last 31 depicted in ghost lines. A lasting allowance 32 of the upper can be seen beyond the shoe last 31 and includes the polymeric binding 18. A waterproof insole 34 can be seen resting against the shoe last 31.

The waterproof insole may be waterproof leather, waterproof artificial leather, waterproof leather board, waterproof cellulosic board, waterproof polymeric board, waterproof fabric, or combinations thereof.

Still referring to Figure 3, a folded lasting allowance 33 can be seen folded over the waterproof insole 34 on the shoe last 31.

The polymeric binding 18 is applied to the upper 11 before the upper is folded over the waterproof insole 34, therefore the polymeric binding is applied to the upper when the upper is planar and free of creases or folds, thereby allowing the polymeric binding to effectively cover the upper where it is applied without the formation of gaps in the polymeric binding in order to present an unbroken polymeric surface for subsequent sealing. This may be done prior to placing the upper on a shoe last or after placing the upper on a shoe last, but in all cases prior to folding the upper over the waterproof insole.

Referring to Figure 4, as the lasting allowance 32 is folded over the waterproof insole 34, pleats 41 in the lasting allowance form particularly in the toe area 42 and heel area 43 of the upper 11. The formation of these pleats is a result of the upper, which is planar in nature, being tautly folded around the rounded periphery of the toe and heel areas of the waterproof insole. The polymeric binding 18 is present on the inside and outside surfaces of the pleats. The polymeric binding having been applied prior to the folding step ensures an adequate amount of polymer material present in all the pleats which are formed when the lasting allowance of the upper is folded over the waterproof insole in the formation of the waterproof footwear.

Returning to Figure 3, while on the shoe last 31, the folded lasting allowance 33, which includes the polymeric binding 18 of the upper, is attached through a lasting step to the bottom surface of the waterproof insole 34.

In the lasting step, the polymeric binding of the upper is sealed to the waterproof insole through various means. If the polymeric binding or the bottom surface of the waterproof insole is of a material that is thermoplastic in nature and capable of softening and flowing to form a waterproof seal, the application of heat may be used to effectuate a seal between the bottom surface of the waterproof insole and the polymeric binding. Alternatively, an additional amount of a sealant material may be used to effectuate a seal between the polymeric binding and the bottom of the waterproof insole. The sealant material must thoroughly wet and bond both the waterproof insole and the polymeric binding.

Referring to Figure 5, an outer sole 52 is attached to the bottom surface of the waterproof insole 34 and the outer sole is made of a material and is of a design that it is capable of contacting the ground so that a functional article of footwear is formed. The outer sole is preferably attached to the waterproof insole 34 and the polymeric binding 18 of the upper, through the use of an adhesive 51.

The term "outer sole" is used to include midsoles, outer soles, and combinations thereof.

The outer sole may be polyurethane, natural rubber, synthetic rubbers, leather, artificial leather, polyvinyl chloride, ethylene vinyl acetate or combinations thereof.

In the final step, the article of footwear is removed from the shoe last.

Alternatively, referring to Figure 6, the outer sole 52 may be attached to an upper shell 61 through an adhesive process. The upper shell may be leather, artificial leather or fabric.

Referring to Figure 7, an alternate embodiment of the waterproof footwear of this invention is depicted wherein the

upper shell 61 is attached to the outer sole 52 by means of a physical attachment. In Figure 7, the means of physical attachment depicted is a stitch 71. Alternatively, the means of physical attachment may be a staple or a nail.

TEST DESCRIPTIONS

WATER VAPOR TRANSMISSION RATE (WVTR)

A description of the test employed to measure water vapor transmission rate (WVTR) is given below. The procedure has been found to be suitable for testing the materials and products of this invention.

In the procedure, approximately 70 ml. of a solution consisting of 35 parts by weight of sodium chloride and 15 parts by weight of distilled water was placed into a 133 ml. polypropylene cup, having an inside diameter of 6.5 cm. at its mouth.

An expanded polytetrafluoroethylene (PTFE) membrane having a WVTR of approximately 34,200 g/(m^2 x 24 hr.) as tested by the method described in USP 4,862,730 to Crosby, and available from W. L. Gore & Associates, Inc. of Newark, Delaware, was heat sealed to the lip of the cup to create a taut, leakproof, microporous barrier containing the solution. A similar expanded PTFE membrane was mounted to the surface of a water bath. The water bath assembly was controlled at 23°C plus or minus 0.2°C, utilizing a temperature controlled room and a water-circulating bath.

The sample to be tested was allowed to condition at a temperature of 23°C and a relative humidity of 50% prior to performing the test procedure. Samples were placed in contact with the expanded polytetrafluoroethylene membrane mounted to the surface of the water bath.

The cup assembly was weighed to the nearest 1/1000 g and was placed in an inverted manner onto the center of the test sample.

The sample was tested for 30 minutes and the cup assembly was removed and reweighed within 1/1000 g.

The WVTR of the sample was calculated from the weight gain of the cup assembly and was expressed in grams of water per square meter of sample surface area per 24 hours.

HARDNESS TEST FOR POLYMERS

The ASTM Standard Test Method D2240-86 for Rubber Property - Durometer Hardness is used to measure polymer softness. The method is based on the penetration of a steel indentor forced into a material for a specified time. A Type D scale durometer was used.

A larger D reading indicates a harder material.

EXAMPLE

A women's style boot was made with upper materials consisting of an upper shell of approximately 170 g/m^2 nylon taffeta fabric, and an upper consisting of a water-impermeable and air-impermeable layer of expanded microporous PTFE membrane, (GORE-TEX® membrane available from W. L. Gore & Associates, Inc., Newark, Delaware), manufactured according to the teachings of the USP Nos. 3,953,566 to Gore, and 4,194,041 to Gore, et al., incorporated herein by reference. The water-impermeable layer was laminated on one face to a nylon tricot knit weighing approximately 50 g/m^2 and on the other face to the foamed side of a polyester/nylon tricot knit weighing approximately 130 g/m^2 backed with a polyurethane foam approximately 0.12 cm thick. The upper was water vapor-permeable, having a WVTR of approximately 1000 $g/(m^2 \times 24 \text{ hr.})$, as tested by the WVTR method described above. The insole was cellulosic, (available from Georgia Bonded Fibers, Inc., Buena Vista, VA). The outer sole was a composite polymer.

A polyurethane adhesive in solvent form was made by synthesizing a polyurethane polymer in dichloromethane solvent at 25% solids level. The approximate molar equivalent ratio was (1.0:0.805:0.2) dicyclohexylmethane-4,4' diisocyanate: 2,2'-oxybis(ethanol):poly(oxyethylene) glycol (avg. M.W. 1420). Dibutyltin dilaurate was used as a catalyst (approximately 0.65 wt. % of diisocyanate). When synthesis had proceeded so that the free isocyanate content had fallen to 0.13% by a standard dibutylamine titration procedure, dibutylamine (approximately 0.60 wt. % of diisocyanate) was added.

A 76 um thick film of the polyurethane adhesive had a measured WVTR of 4500 g/(m^2 x 24 hr.).

The bottom surface of the cellulosic insole was coated twice with the polyurethane adhesive in solvent form and allowed to dry tack-free between each coating step. This procedure effectively waterproofed the bottom surface of the insole. The waterproof insole was attached with two nails to a shoe last with the side containing the polyurethane adhesive away from the shoe last surface.

The upper shell and upper were cut and stitched separately. Stitched seams in the upper were sealed through the use of a thermoplastic adhesive tape (GORE-SEAM™ tape, available from W. L. Gore & Associates, Inc., Newark, Delaware) in order to ensure waterproofness of the upper.

The upper shell and the upper were then stitched together at the proximal opening of the upper forming a collar but not at the distal opening in the area of the lasting allowance of the upper.

The polyurethane adhesive in film form was employed as the polymeric binding for the upper. To obtain a film, the polyurethane adhesive in solvent form was cast onto release paper using a coating knife and the solvent was evaporated. The resulting polyurethane film was approximately 100 um thick. Durometer hardness of the polyurethane film was approximately 35 D. The polyurethane film was thermoplastic and could be melted by applying approximately 90°C heat.

Heat from a hand held iron was employed to melt and transfer the polyurethane film from release paper to the distal edge of the upper. At the high dry heat setting of the iron, the polyurethane film transferred easily after about 10 seconds onto the surfaces of the upper. Approximately 2 cm of the inside surface of the distal edge of the upper was continuously coated with the polyurethane film, and approximately 1 cm polyurethane film was left extending over the distal edge of the upper.

The upper was then turned over and heat was again employed to transfer the polyurethane film onto the outside surface of the distal edge of the upper. Approximately 2 cm of the outside surface of the distal edge of the upper was continuously coated with the polyurethane film, and approximately 1 cm polyurethane film was left extending over the distal edge of the upper. In this step, the extending polyurethane film from the inside surface was melt-bonded to the extending polyurethane film from the outside surface at the distal edge of the upper, thus binding or sealing the distal edge of the upper. The polymeric binding was now present on the distal edge and on the adjacent inside and outside surfaces of the upper.

A second layer of polyurethane film was placed over the first layer using the same techniques as previously described to obtain a polymeric binding with an adequate thickness.

The upper shell and the upper were tacked to each other with an adhesive at the distal edge of the upper. Stitching through of the polymeric binding of the upper was avoided so that the waterproof quality of the polymeric binding on the distal edge of the upper would not be compromised.

The distal opening of the upper was placed on the shoe last to which was nailed the waterproof insole. The lasting allowance, or the length of upper materials extending beyond the shoe last, was carefully folded over the bottom surface of the waterproof insole. In doing so, many pleats appeared in the folded distal edges of the upper shell and the upper, which had the polymeric binding. This pleating was particularly apparent in the toe and heel areas.

To permanently attach and seal the upper to the waterproof insole, an ethylene vinyl acetate (EVA) hot melt cement was employed, (available from Bostik, Boston St., Middleton, MA) in 1 cm diameter thermoplastic rods. The hot melt cement was generously applied with a hot melt gun between the waterproof insole and the polymeric binding of the folded upper. The polymeric binding of the folded upper was then held with hand pressure against the waterproof insole for approximately 30 seconds in order for the hot melt cement to set and hold fast the upper to the waterproof insole.

Next, the two nails which had been driven through the waterproof insole into the shoe last were removed. The holes left by the nails were filled with the hot melt cement to waterproof the waterproof insole again.

The polyurethane adhesive in solvent form was employed as a soling cement. The waterproof insole, the lasting allowance of the upper and the inside face of the composite outer sole were coated with the polyurethane adhesive in the solvent form. The solvent was evaporated and heat from a heat gun was directed to all coated surfaces until the adhesive melted. Then the outer sole was placed into contact with the waterproof insole and the lasting allowance of the upper and pressure from a shoe press was applied for about approximately 5 seconds. The shoe last was removed from the boot.

The boot was tested by the waterproofness method taught in USP 4,799,384 to Casali, incorporated herein by reference. The proximal opening of the upper of the boot was clamped in air tight jaws. Air was fed into the boot from the proximal opening and pressurized to approximately 7 kPa. The air-filled boot was then submerged in a water tank to approximately 5 cm from the clamped jaws. The boot was observed on all sides for one minute for the presence of a continuous stream of air bubbles which indicates a leak. No leak was observed in the boot produced in Example 1, thereby indicating a waterproof boot.

WE CLAIM:

1. An article of waterproof footwear which comprises:
   (a) an upper comprised of a water-impermeable layer and having a proximal opening for receiving a wearer's foot, a proximal edge surrounding the proximal opening, a distal opening, a distal edge surrounding the distal opening, and inside and outside surfaces;
   (b) a polymeric binding adhered to the distal edge of the upper and covering a portion of the inside and outside surfaces of the upper adjacent to the distal edge;
   (c) a waterproof insole having a top surface for supporting the wearer's foot and a bottom surface sealed to the polymeric binding; and
   (d) an outer sole.
2. An article of waterproof footwear as defined in Claim 1 wherein the polymeric binding is in the form of a solid material.
3. An article of waterproof footwear as defined in Claim 1 wherein the polymeric binding is in the form of a foamed material.
4. An article of waterproof footwear as defined in Claim 1 wherein the polymeric binding is polyurethane.
5. An article of waterproof footwear as defined in Claim 1 wherein the polymeric binding is natural latex rubber.
6. An article of waterproof footwear as defined in Claim 1 wherein the polymeric binding is nitrile rubber.
7. An article of waterproof footwear as defined in Claim 1 wherein the polymeric binding is silicone rubber.
8. An article of waterproof footwear as defined in Claim 1 wherein the polymeric binding is butyl rubber.
9. An article of waterproof footwear as defined in Claim 1 wherein the polymeric binding is fluorinated rubber.
10. An article of waterproof footwear as defined in Claim 1 wherein the polymeric binding is polyester.

11. An article of waterproof footwear as defined in Claim 1 wherein the polymeric binding is copolyether polyester.
12. An article of waterproof footwear as defined in Claim 1 wherein the polymeric binding is ethylene vinyl acetate.
13. An article of waterproof footwear as defined in Claim 1 wherein the polymeric binding is polyamide.
14. An article of waterproof footwear as defined in Claim 1 wherein the polymeric binding is a material having a hardness value less than or equal to 55 D Durometer and greater than or equal to 5 D Durometer.
15. An article of waterproof footwear as defined in Claim 1 wherein the polymeric binding is a material having a hardness value less than or equal to 45 D Durometer and greater than or equal to 30 D Durometer.
16. An article of waterproof footwear as defined in Claim 1 wherein the water impermeable layer is comprised of a layer of a polymeric material.
17. An article of waterproof footwear as defined in Claim 16 wherein the polymeric material is selected from a group consisting of polytetrafluoroethylene, polyvinyl chloride, natural rubber, synthetic rubbers, polyester, polyamide, polyurethane, polyethylene and polypropylene.
18. An article of waterproof footwear as defined in Claim 1 wherein the water-impermeable layer is selected from a group consisting of waterproof leather, waterproof artificial leathers and waterproof fabrics.
19. An article of waterproof footwear as defined in Claim 1 wherein the water-impermeable layer is a breathable polymeric membrane.
20. An article of waterproof footwear as defined in Claim 19 wherein the breathable polymeric membrane is selected from a group consisting of polyurethane, polyester, polyethers, polyamides, polyacrylates, copolyether esters and copolyether amides.

21. An article of waterproof footwear as defined in Claim 19 wherein the breathable polymeric membrane is microporous polytetrafluoroethylene.
22. An article of waterproof footwear as defined in Claim 21 wherein the microporous polytetrafluoroethylene is expanded microporous polytetrafluoroethylene.
23. An article of waterproof footwear as defined in Claim 1 further comprising an upper shell attached to the outer sole.
24. An article of waterproof footwear as defined in Claim 23 wherein the upper shell is leather.
25. An article of waterproof footwear as defined in Claim 23 wherein the upper shell is fabric.
26. An article of waterproof footwear as defined in Claim 23 wherein the upper shell is artificial leather.
27. An article of waterproof footwear as defined in Claim 1 wherein the upper further comprises an outside surface material.
28. An article of waterproof footwear as defined in Claim 27 wherein the outside surface material is leather.
29. An article of waterproof footwear as defined in Claim 27 wherein the outside surface material is artificial leather.
30. An article of waterproof footwear as defined in Claim 27 wherein the outside surface material is fabric.
31. An article of waterproof footwear as defined in Claim 27 wherein the outside surface material is laminated to the water-impermeable layer.
32. An article of waterproof footwear as defined in Claim 27 wherein the outside surface material is attached to the water-impermeable layer at seams contained in the upper.
33. An article of waterproof footwear as defined in Claim 1 wherein the upper further comprises an inside surface material.
34. An article of waterproof footwear as defined in Claim 33 wherein the inside surface material is leather.
35. An article of waterproof footwear as defined in Claim 33 wherein the inside surface material is artificial leather.

36. An article of waterproof footwear as defined in Claim 33 wherein the inside surface material is fabric.
37. An article of waterproof footwear as defined in Claim 33 wherein the inside surface material is laminated to the water-impermeable layer.
38. An article of waterproof footwear as defined in Claim 33 wherein the inside surface material is attached to the water-impermeable layer at seams contained in the upper.
39. A method for producing an article of waterproof footwear which comprises the steps of:
    (a) forming an upper having a proximal opening for receiving a wearer's foot, a proximal edge surrounding the proximal opening, a distal opening, a distal edge surrounding the distal opening, and inside and outside surfaces;
    (b) adhering a polymeric binding to the distal edge of the upper and covering a portion of the inside and outside surfaces of the upper adjacent to the distal edge;
    (c) sealing the bottom surface of a waterproof insole to the polymeric binding;
    (d) attaching an outer sole.

FIG. 1

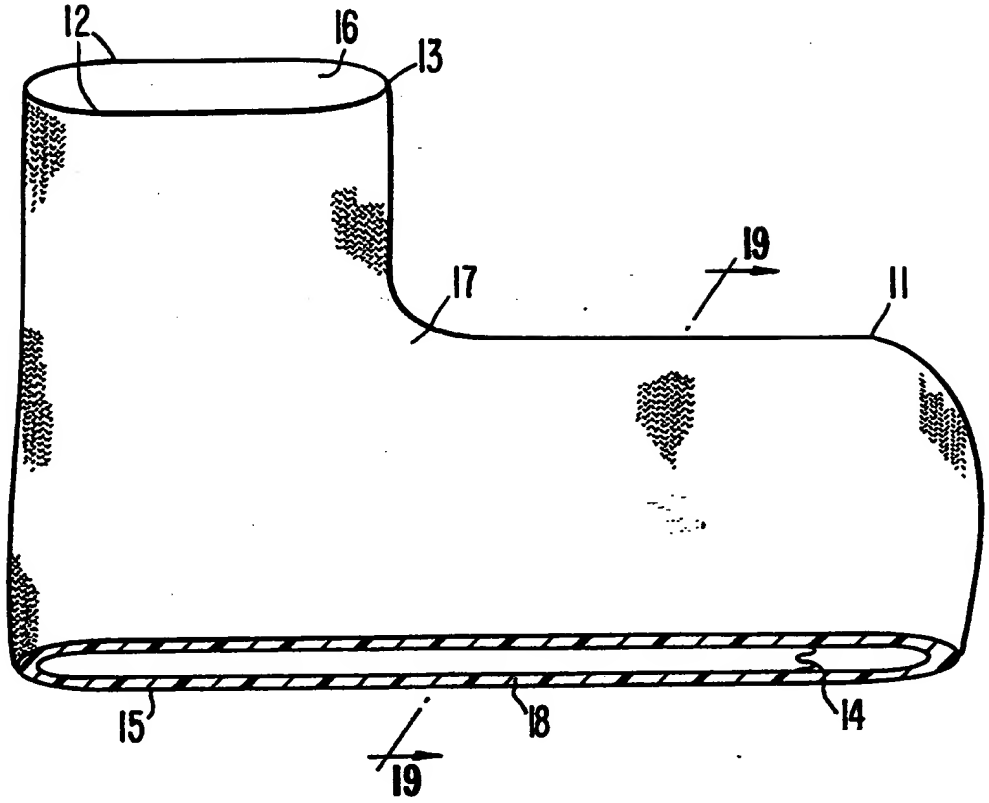
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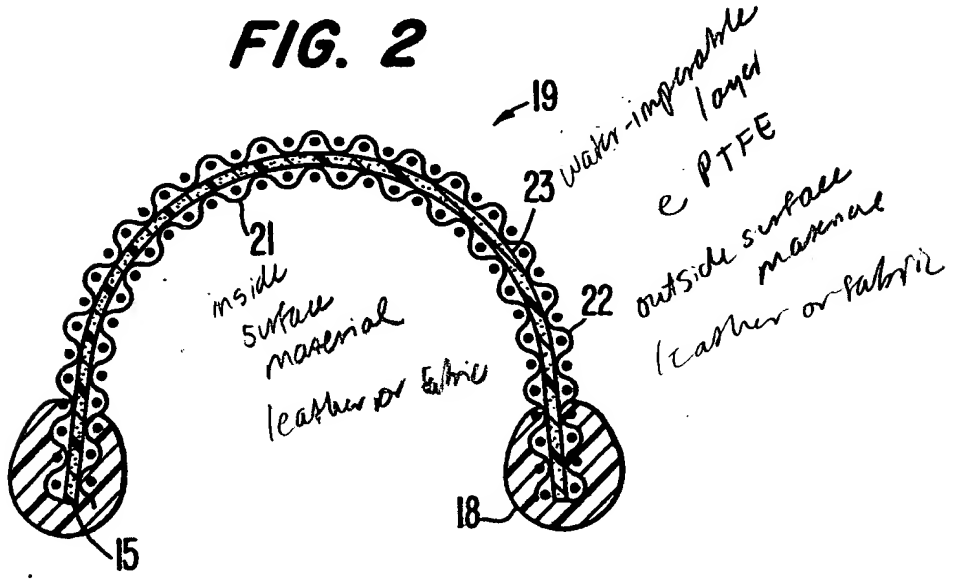
FIG. 2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water-impervious layer e PTFE
23
21
inside surface material leather or fabric
22
outside surface material leather or fabric
18
15

FIG. 3

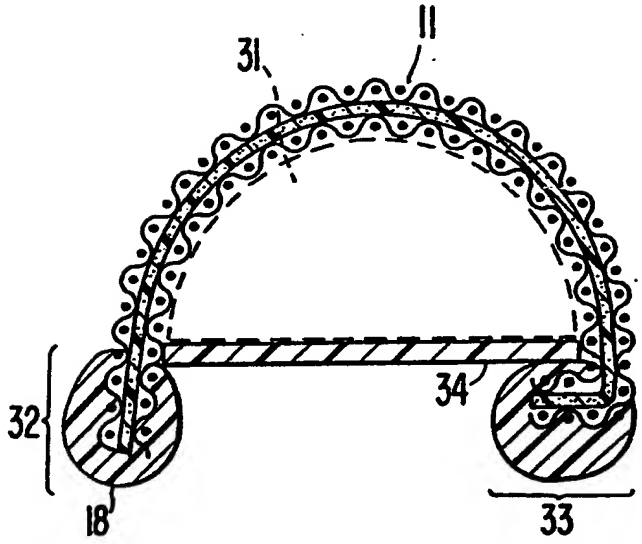


FIG. 4

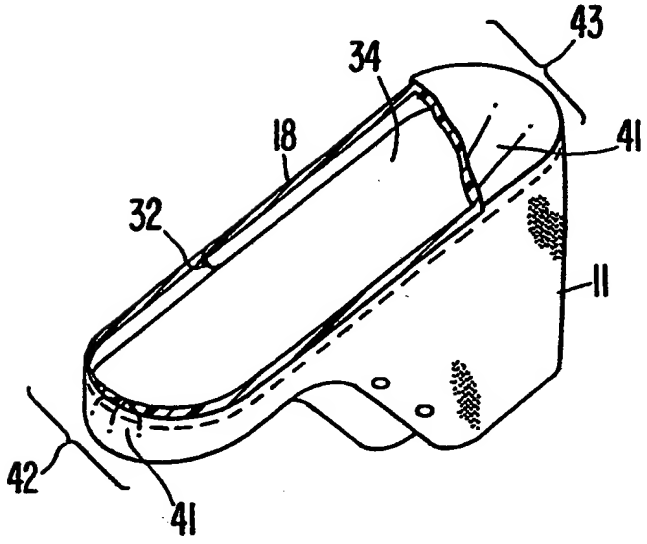


FIG. 5

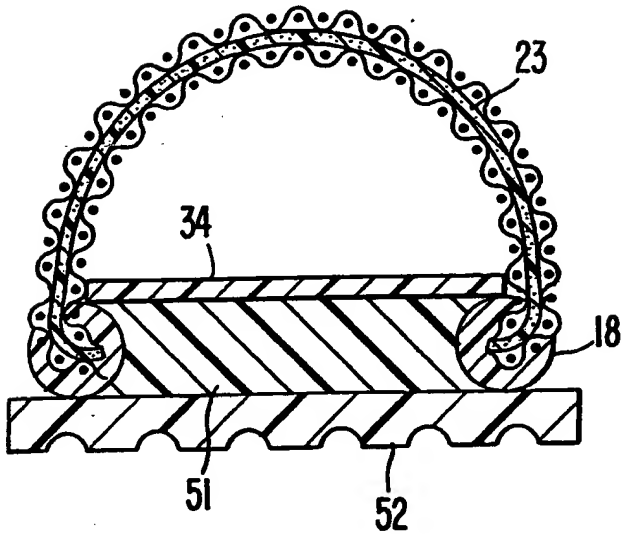


FIG. 6

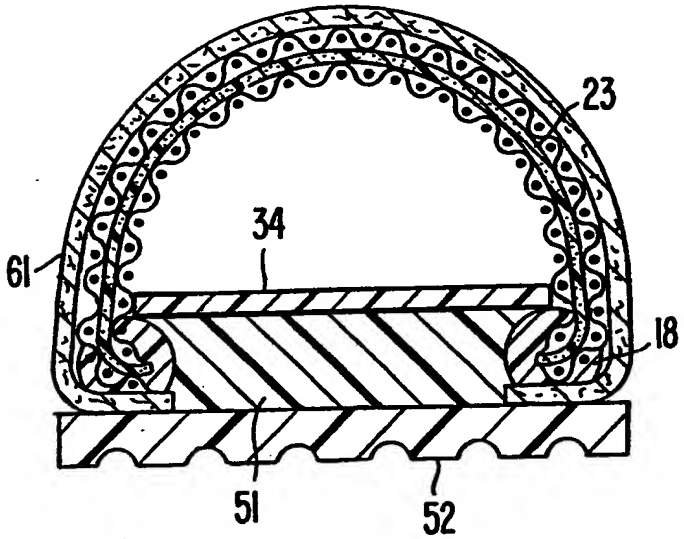
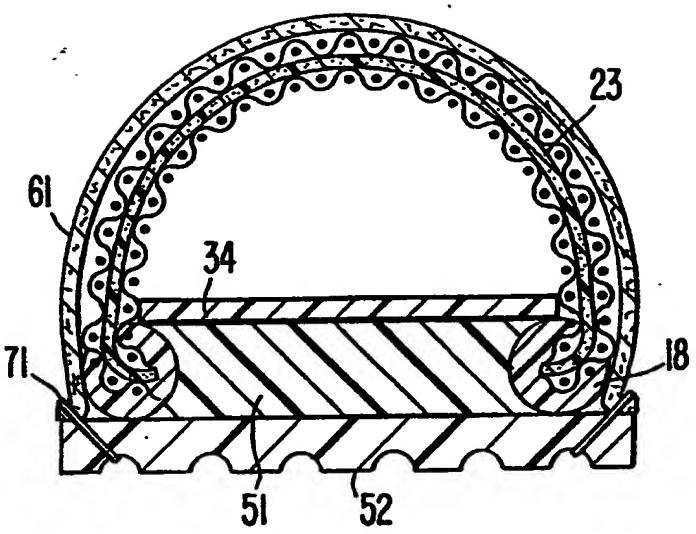


FIG. 7



INTERNATIONAL SEARCH REP RT

International Application No PCT/US 92/05702

I. CLASSIFICATION F SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 A43B7/12; A43B9/12

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	A43B

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category[10]	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
Y	EP,A,0 284 638 (KUK SCHUHFABRIK GMBH) 5 October 1988 see column 2, line 2 - line 48; claims 1,2,6,7; figures ---	1,2,4, 16-39
Y	DE,U,8 914 377 (AUMANN) 19 April 1990 see the whole document ---	1,2,4, 16-39
A	US,A,3 919 035 (WARRACH) 11 November 1975 see the whole document ---	5-13

-/---

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
22 OCTOBER 1992	04. 11. 92
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	MATHEY X.C.M.

Form PCT/ISA/210 (second sheet) (January 1985)

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category °	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
A	WO,A,9 006 067 (LOWA-SCHUHFABRIK LORENZ WAGNER GMBH) 14 June 1990 see page 12, line 7 - page 13, line 9; figures 1-4	1,2,4, 16-24, 27,29, 31,33, 36,37,39
A	US,A,4 819 345 (MULCAHY ET AL.) 11 April 1989 see the whole document	1,16-30, 33-37,39

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. US 9205702 SA 62372

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on
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Patent document cited in search report	Publication date	Patent family member(s)		Publication date
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